

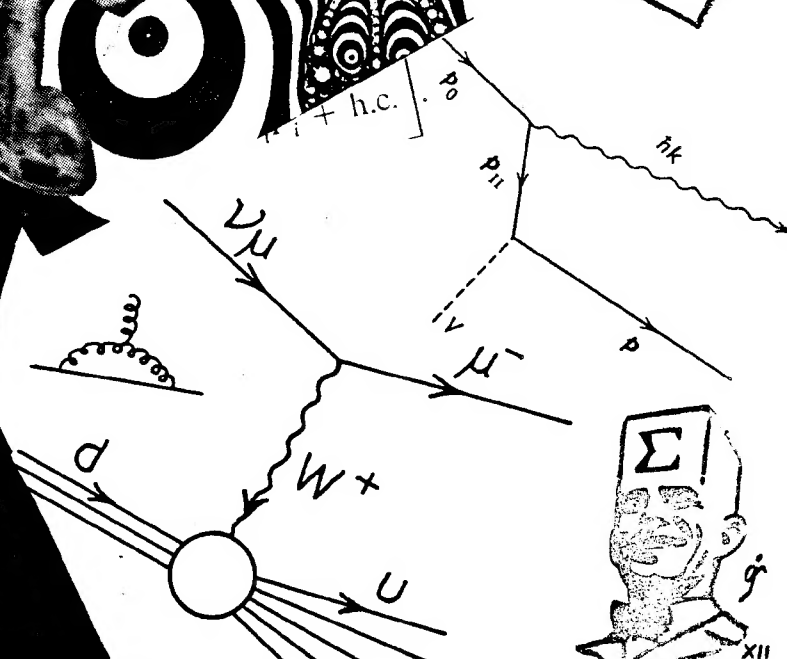
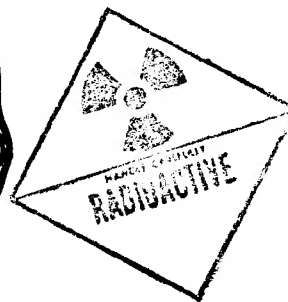
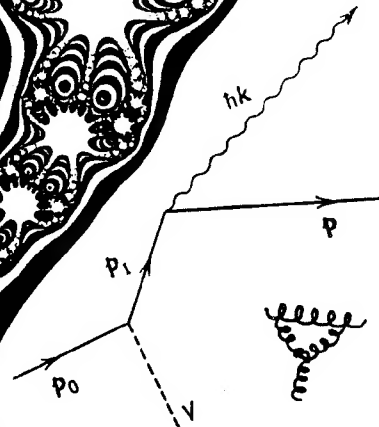
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$$\Phi_i \Phi_j = A_i(y) A_j(y) + \sqrt{2\theta} [\psi_i(y) A_j(y) + A_i'(y) \psi_j(y)] + \theta [A_i(y) F_j(y) + A_j(y) F_i(y) - \psi_i(y) \psi_j(y)]$$

$$\Phi_i \Phi_j \Phi_k = A_i(y) A_j(y) A_k(y) + \sqrt{2\theta} [\psi_i A_j A_k + \psi_j A_k A_i + \theta \theta [F_i A_j A_k + F_j A_k A_i - \psi_i \psi_j A_k - \psi_j \psi_k A_i - \psi_k \psi_i A_j]]$$

$$\Phi_i^\dagger \Phi_j = A_i^*(x) A_j(x) + \sqrt{2\theta} \psi_j(x) A_i^*(x) + \sqrt{2\theta} \bar{\psi}_i(x) A_j(x) + \theta A_i^*(x) F_j(x) + \theta \bar{F}_i(x) A_j(x)$$

$$\left[\frac{i}{\sqrt{2}} \sigma_{\alpha\dot{\alpha}}^m (A_i^* \partial_m \psi)_{\dot{\alpha}}^{\alpha} \right]$$



DECEMBER 1988

THE 555 TIMES

A P A - T E C H 6 2

The Amateur Press Association for General Technics

G.T. Buckfast
+ Shalmaneser

Greg Ruffa, 1004 7th Street, S.E., #103,
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The minimum activity required is two pages every four months.
The copy count for the APA is twenty (20).
The deadline for APA-TECH 63 is Wednesday, 1 February 1989.

It's been a while since we're inflicted some Ritual Public HumiliationTM.
Valli and Joa, Bob and Connie, and Rolf, please send in some money!
Dave L., Donna and Tullio, Bob and Connie, Guy W., and Rolf, please send in
a missive, epistle, notice, appraisal, scrawl, communiqué, manifesto, jotting, data-file, pronouncement

An', by the way, folks, Annette and I sure would like to see someone else send in
a cover now and again. Please?

Your account, before postage, stands at:

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It was good (it was fun!) to see many of you down at Windycon last month. I hope to get to about one convention per season, although I probably won't be at a Worldcon until '91 (too many other things are happening that time of year).

I'm pulling this together as quickly as possible, since I have to get it in the mail tomorrow morning (the 10th), before I leave town for the rest of the year. Let me mention a couple of administrative things. Don't forget that the annual APA dues of \$2 are collected every January. If your account is pretty low or (*gasp*) even **negative**, send me some additional money by next time. If you decide to send your originals here for me to copy, please bear in mind that the **best** price I can now manage is 4¢ each and, more usually, 5¢ each. Things don't seem to be as competitive here as they were in San Diego, Kinko's is no friend to the impoverished student, and I have to leave things overnight to get 4¢.

Well, on to the APA. Happy Holidays from the Frozen North!

Shal.

Happy Holidays, 1988



Crumbcrunchers, Inc.
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Late October 1988

It will be December by the time you read this. But I am still in early autumn now, not yet ready to think of Christmas! The frost has gotten all the "summer vegetables" and flowers, though I still have some zinnias blooming. Some people have also managed to keep their petunias and geraniums by covering them carefully on nights when frost threatens. After we finally got some rain, quite a few flowers suddenly flourished; a tiny vinca I was given for Mother's Day sent out shoots like crazy and became quite a substantial plant. There were other plants that didn't get started until later in the season, too. I discovered some volunteer tomato plants in the flower bed next to the kitchen door. They didn't even bloom until late September! (Obviously, we got no tomatoes from them!)

If you live on the edge of a woods, in the autumn you may look out the window each day to see yellowing and bronzing leaves twirling down from branches that are growing barer by the hour. Then some of Shakespeare's sonnets, so many of which dwell on coming age and change, may come to mind. Sonnet 73 is perhaps the most familiar of these - "That time of year thou mayst in me behold/When yellow leaves, or none, or few, do hang"The leaves of the alanthus trees invariably turn yellow, though many of them are still green. "Upon those boughs which shake against the cold,/Bare ruined choirs, where late the sweet birds sang...." The skeletal branches of the black locust tree at the side of the house are nearly leafless. A Baltimore oriole and his mate built one of their hanging basket nests, high near the top of that tree, this past spring....

Autumn is a great time for using what I call "paintbox color" words to describe the myriad colors of the leaves. Burnt sienna, for example. Cadmium red. Burnt umber. Cadmium yellow. Ochre. Sometimes even alizarin crimson (especially good for dogwoods and Japanese maples). And other color words that maybe don't get used so often, like russet. The hillsides are turning all these colors, despite the fact that I'd read that they might be more subdued this year, because of the drought.

Of course, autumn also heralds Halloween, a very important holiday if you have a youngster in the house! We have two pumpkins sitting either side of the front door, waiting to be carved, and have been working on a costume. Costume requests ranged from angel, clown, bat, spider, and Dracula, to "grown-up lady." But after leafing through a book of medieval costumes, Marlene decided that she would be a sorcerer. Or as she says, "sorc'ress." A long gown and sash, medallion around the neck, a tall pointy hat decorated with moons and stars, and of course a magic wand, are the components of the costume right now. We still have to finish the cloak, which is made from an old blanket.

Marlene has a pretty good idea of what a "sorc'ress" should do and how she should behave. I'm not sure where she picked up her knowledge, unless it's from our reading *The Hobbit*. (That's another story which I'll probably get to in the next paragraph.) She practiced casting spells to Gustav Holst's "The Planets" the other evening. The next day, I told her the story of "The Sorcerer's Apprentice," and she wanted to hear the music right away. We played it and she did spell casting to Dukas also. She was puzzled that there were no words to the music, since there's a story that goes along with it, but she listened very carefully. She was especially fascinated by the "drops of water" that you hear near the end of the piece.

Ah, yes, *The Hobbit*. Dave has a set of figurines representing the characters from the TV movie of *The Hobbit*. I had them wrapped up and packed away, but thought that I'd put them on the mantelpiece, since Marlene now understands (well, more or less) the difference between decorations and playthings. (I still keep my special breakable ornaments up high, however!) The minute she heard that the dwarves, Gandalf, Smaug, Gollum, Bilbo and Elrond were in a book, she wanted to have the book read to her. Though I really think that she's a bit too young for *The Hobbit*, she listens quite attentively when I read, and remembers a good bit of the story.

Since my paperback copy of the book has no pictures, we found the edition with illustrations by Michael Hague at the library. I was really hoping to find a copy with pictures from the TV movie, but no such luck. Though Michael Hague is not an illustrator that I've really studied, it seems that he is trying to emulate N.C. Wyeth in his illustration style.

While still (sort of) on the subject of Halloween, I must tell you about the very unusual "haunted house" that a group here in Ripley has gotten up. It's a "Haunted Hotel" which has been set up in a really truly hotel in downtown Ripley. This hotel was actually in use as late as 1981 (David stayed there when he came down for his interview with Dayton Power and Light), though given its derelict state, one cannot imagine anyone staying there! (I'm sure it was in somewhat better condition seven years ago, but the fact that they charged only \$10 a night, and there was no hot water would seem to indicate that it was pretty shabby even then.) The owner did commit suicide in the building, and (supposedly) several guests died there over the years (though this is of course unsubstantiated, and nobody is saying whether the deaths were due to natural or unnatural causes).

They've carried the hotel theme pretty well throughout, with various nefarious doings in different bedrooms, a lot of ghoulish monsters sitting in the bar, drinking and playing cards, a scary desk clerk in the lobby (and also a "guest who died of fright" displayed in a coffin), etc. I found it appropriately frightening, especially one room which was disturbingly similar to the final scene in *Looking for Mr. Goodbar*. I suppose an aficionado of horror films would have considered it rather tame, but I thought it was quite effective.

Marlene and I got hustled through rather quickly, so we weren't able to get the "full effect" of some of the rooms. I think this was because our guide worried that MR might get really scared. She didn't say anything, though our guide said that "she jumped a couple times." Some of our friends who were playing roles took the edge off a bit by saying, "Hi, Marlene." On asking her about it later, the only thing that truly impressed her was the "night man." We figured out that this was a hanged man (dressed in his nightshirt) who hung in the hallway and raised his head and roared at you as you passed.

One of my several sisters-in-law, who is an optometrist, has been telling me of research that indicates that maybe age six is a bit early to start putting so much emphasis on reading, math, etc. There's so much else children this age need to learn and are much more receptive to, according to this research. These skills come much easier to children a few years older. A niece, who just started first grade this year, had a fierce dislike for kindergarten, because the teacher emphasized academics so much. When we visited her and her family just before school was out, we saw the daily shouting matches she had with her mother, just before the bus arrived. "I hate school! I hate kindergarten! I don't want to go!" Et cetera.

I wondered what a child getting ready for kindergarten should be able to do. Recite the alphabet? Be able to count to 20? Be able to write his name? Though I take mother's tales with a grain of salt when they tell you about all the words their four-year-olds can write and read (just as I disbelieved the mother who told me her two-year-old had been toilet-trained at 10 months!) I do know that my sister's girl was writing short messages when she was four. Now that she's five, she's sending us three -and -four -sentence

communications. Marlene enjoys (sometimes) put her ragged M and R on pictures she's drawn and cards we send, but she's not much interested in other letters yet.

So what are prekindergarten skills? Well, can your (hypothetical) child:

- Count to 10
- Recognize numbers out of order
- Repeat a series of four numbers without practice
- Alternate feet walking downstairs
- Repeat 8 to 10 word sentences
- Identify and describe simple words
- Identify geometric shapes (circle, triangle, square)
- Pay attention to a short story
- Answer simple questions about a story after it has been read
- Recognize objects that are alike and different
- Care for toilet needs by himself
- Accept responsibility of dressing and undressing himself.
- Share with others
- Take turns
- Respect authority and be courteous.
- Listen without interrupting
- Walk a straight line
- Tell missing parts if you draw a head and leave off eye, ear, etc.
- Show interest in writing.
- Say full name, address and phone number
- Say parents name
- Cut and paste
- Draw and color beyond scribbling
- Build with blocks
- Follow simple directions
- Draw these shapes: circle, square, triangle
- Button, snap and zip own clothing
- Be sent on an errand (example: to the mailbox)

That's a *lot* of skills for a five-year-old to have mastered! There's really no room in there for learning how to read too! Reciting the alphabet is pretty much just rote memorization, and the connection between letters and the written word is still to come. I can tell the skills we have to work on - learning to listen without interrupting is a big one! We've finally triumphed with learning name, address and phone number - something we've been working on ever since she got lost in a discount department store. (She was eventually found, of course, at the back of the store, playing with the toys.)

Well, Dave has carried off the APA, so I'll have to rely on my memory in making comments to you.

MAILING COMMENTS

Bill: Thanks for the invite to the Midwest Space Conference. Dave enjoyed it immensely. I wished I could have attended too, but I had to work at the Brown County Fair that weekend.

Pleased to see *Chaos* on your reading list, as Dave just bought a copy, and I've started to read it myself. His interest was first piqued by conversations with a colleague (he later found out that the fellow had not even heard of the book, although he had been discussing some of the ideas contained therein).

Audrey and Gabe: Ah, garage sales! I have restrained myself quite well this summer, I think. Most of my garage sale expenditures have been for children's clothing. I must admit, however, to coming home

from one sale with *The Collected Hercule Poirot*, *A Tree Grows in Brooklyn*, *Poetry of the Western World*, five juice glasses and a geranium! (The fact that I'm almost always on my bicycle or on foot forces me to be a bit more discriminating than I might be otherwise.) We have avoided auctions since disappointments with a refrigerator (a frost-free model which needs to be defrosted every two weeks) and washing machine (only six months old, according to the auctioneer, but it will only wash clothes in one "mode" and will frequently shake so violently that it pulls the plug out of the wall). I did tell Dave (with some trepidation) about an auction this weekend. He came home empty-handed (whew!), saying that it was mostly junk. There was a dock, he said, but we aren't yet at the stage where we're thinking of developing the waterfront portion of our property!

My first science fiction novel was actually not a Heinlein; I think it was probably *A Wrinkle in Time*, which was read to me (and my sister, of course), when I was about nine. I also began to read a lot of Andre Norton at about the same age, although I eventually got bored with her. But I did read *Stranger in a Strange Land* the summer I turned twelve, though I had a lot of trouble with it in spots. I also read *Lord of the Rings* that same summer - well, actually, I read up to the point where Frodo gets bitten by Shelob the Spider, and there I stuck. That passage made me feel almost physically ill, and it upset me so much that I didn't go back and finish reading the books until I was in college.

Rod: Whenever something comes up missing, I say, oh well, it must still be packed away in a box. A good excuse, since I suspect that some things have vanished permanently, having somehow gotten mislaid during moving. (Especially important things like check books and tax records. There is also a two-record set of Sesame Street songs that I simply cannot find - not that I miss it, as I know most of the songs by heart, due to Marlene's having listened to them over and over and OVER again.)

Annette: Who would I like to talk to in the past? The creator (or creators) of the Shroud of Turin. The aura of mystery surrounding this and other religious relics fascinates me (is this just the skeptical scientist and Unitarian in me?). And of course I would ask him/her/them "How did you do it?!" With my luck, however, I would probably forget all about the encounter when I returned to the present (in the tradition of the majority of "time travel" stories I've read) or worse, I would be unable to understand the archaic form of whatever language that person or persons spoke.

Speaking of time travel, one of the things I "collect" is the titles of novels which fall into the "space and time" category. A lot of these are children's books, and I credit some of them with interesting me in various periods of history. *A Traveler in Time* by Alison Utley, for example, deals with the plot to free Mary, Queen of Scots from her prison. *Over Sea, Under Stone* by Susan Cooper got me really going on King Arthur, The Idylls of the King, Tristan and Iseult, and Wagner, and so on and so on.... (Sounds like a lot, but I've always been a voracious reader. In fact, I think the punishment meted out by my parents that hurt the most was the loss of my library privileges for a whole six weeks, because I'd brought home a D in algebra. The odd thing about algebra was that I really enjoyed it - I just wasn't very good at it. It was, after all, in algebra class that I first learned that a tesseract was actually something that scientists had theorized, and not just a word (and concept) that Madeleine L'Engle had made up!)

Valli: Isn't it odd how different people have different definitions of what is old? Here in the US, Colonial structures are definitely "old." To me, a house built in 1840 is old. When I was working for the Landmark Society in Rochester (NY), I proudly took some English friends on a tour of Cornhill, a section of Rochester where there are many 1830s and 1840s houses. I spouted all my architectural knowledge, but "Pooh!" they said. "These houses aren't old. Why we have buildings in England that were built in the 12th century!" I suppose I really shouldn't have gotten upset, as I suspect it was just a typical example of British chauvinism.

Greg: I wonder what it is about squirrels and students?! The squirrels on the Ohio State campus will almost walk up to you and jump in your lap! Students will sit on the benches on the Oval and feed them peanuts. (Pigeons aren't as obvious, and don't get the same treatment.) I never realized before I had the chance to see so many squirrels that they undergo a coloration change like many other animals in winter, though of course it's more subtle. The fur on the paws and ears turns white (or at least gets lighter).

Whoops - end of the page! Best wishes for 1989!

SUSANNAH

INTERESTING TIMES

Linda Struwe Matsushita
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With the arrival of APA 61, I believe it has been a full year since my last contribution. I am pleased (and somewhat surprised) to still be counted among the living. I humbly doff my cap to Shalmaneser.

I haven't even had time to read the past few issues. But when I got 61, I was prompted to go back and read them. I'd forgotten how much fun it is to read about what everyone has been up to.

A few quick notes on things I would have said, but haven't...yet.
Barry: Congratulations! Trumpets, fanfare, confetti, etc.
Audrey & Gabe: Welcome to APA....NORAD sounds like a great place.
Bob & Connie: Your cure for leg-pain works great! No prob since then!

Let's do this chronologically, and save the big news for last. (No fair reading ahead.)

As many of you know, Yas & I were in the States last year for Christmas/New Year. Touring the country during one of the worst winters in recorded history was at least interesting if not always easy. The Grand Tour ran from Osaka to San Francisco to Chicago to Baltimore to Chicago to Kalamazoo to Chicago to Laporte to Benton Harbor to Chicago to Tucson to Denver to San Francisco to Osaka. We travelled by car, train and plane...but alas not boat. The reason for all this jumping around was (mostly) business. Yas interviewed with 3 companies at 5 different sites. From this he got an offer from the company in Baltimore - which we turned down. Laporte/Benton Harbor couldn't make an immediate offer, but told him to contact them again in the fall. So we came back to Japan and returned to our usual hectic schedules.

My sister, Cheryl, had her second baby last June. As I had a 1½ month break between classes, I went back to Chicago for about a month. Yas stayed here. I spent almost all the time with my sister and two nephews. I also managed to get up to Ka'zoo to see Donna & Tullio for a few days. Alex convinced us to go to the Hot Air Balloon Show, which is an annual event in Battle Creek. It was the first time I'd ever seen a H.A.B. up-close. Unfortunately it was rather windy the evening we went out, so the balloons couldn't launch. We did catch the Golden Knights parachute team, and the very end of one of the stunt flying teams - Blue Angels I think. When it was announced that the balloons wouldn't be going up, we headed back to Alex's, ordered pizza, and watched The Princess Bride. We followed this up with a midnight swimming party, caught about 2 hrs. sleep, and then drove back up to Battle Creek to catch the morning launching. It really was quite spectacular. First they stretch out the balloon, and use a huge fan to blow air into the bag. Once it has some 'puff' to it, they can fire the burner - which is very loud - and continue filling the bag. If there is any wind it gets quite tricky. You of course don't want to ignite the balloon, which is twisting hither and yon. Also, when it's about half full, the balloon wants to fly, so the team has to hold it down.

Donna and I hung around after the launching to see one of the competitions. A second group of balloons had launched downwind of the site (the local airport) and the contest was to navigate back to the site and throw a marker out onto a target. The marker closest to the target obviously wins. Almost everyone miscalculated the wind and were blown east of the airport, completely missing the target. But it was wonderful looking at a sky filled with balloons, stretching from horizon to horizon.

Jumping ahead in our story, we find I've returned to Japan. The new term is soon to begin. My very good friend and co-worker receives news of serious illness in her family and must return to the States immediately. This means we will be understaffed. I end up getting half of her course load - meaning I'm doing 1½ times a full schedule! That's 8 hours a day, 4 days a week, for 8 weeks. Actually, although this was extremely exhausting, it was rather fortuitous. Due to some weird internal politics going on, I've been cut back to only ½ a full schedule. As near as we (the teachers) can figure, the client company's coordinator is hopelessly paranoid. She seems to have decided that the best way to consolidate her power base is to erase all traces of her predecessor of 3 yrs ago. Any thing established to enrich the language program is quietly being cancelled, or allowed to deteriorate through lack of maintenance. Any one who knew of the previous policies is being eliminated. My hours have been cut. The head teacher, at the end of this term, will be asked 'to lend his experience to other situations'. There remains only one other teacher who knows the history. Both of my company's coordinators have been replaced. One was promoted to another city, the other couldn't take the BS anymore and asked for out. It's very depressing watching an excellent program that you've helped develop fall apart in a fraction of the time it took to grow, all due to one person's incompetence.

But that brings us to the big news promised awhile ago (you remember). We are returning to the spacious skies, the amber waves of grain, the purple mountains' majesty, the fruited plain.....actually we're going to the desert. Phoenix, AZ to be specific. To make a long story short (I know - "too late"), an ex-co-worker of Yas' moved to Tokyo, for some reason gave his name to a headhunter. Said headhunter calls Yas. Says Motorola is setting up a plant in Japan and needs Japanese engineers. Said engineers are to be trained in Phoenix for 3 yrs, and then return to Japan. (here's the really good part) Said engineers have the option to remain in the US. Are we interested? Is the Pope Catholic?!

So Yas went to Tokyo to interview with the Motorola people (they were doing a Far East tour). Things looked good, and they asked us out to Phoenix for a plant tour! They flew the two of us over (business class, no less) for a 4 day trip. Put us up in a beautiful hotel, up on a hill so it was overlooking the entire city. They also gave us 2 cars, since Yas needed one to get around to all his interviews (he had 12 with 3 depts. in 2 days) and they wanted me to be free to get around while he was getting around. The upshot of all this is he got a verbal offer from all 3 depts! We're now waiting for the written offers, which will give some more info on each of the jobs so he'll be able to pick the best one for himself.

Now that everything is looking like roses for us, we still can't find the thorns. Not all of them anyway. One big thorn is Yas' VISA status. Since he is the spouse of a citizen, Immigration won't let him go on a business visa (original plan of Motorola) unless he can prove this is a temporary trip. The option to stay throws doubt on that. I was advised to apply for immigrant status for him (as the citizen bringing in the alien, I have to apply not him). Well, I've done that and we've just gotten the second round of forms. It's incredible what you have to go through. Forms and documents that I already submitted in triplicate have to be submitted again in triplicate. And everything has to be notarized. No wonder people try to sneak into the country; the bureaucracy sets up quite a deterrent with all the forms, fees and regulations. It seems the only advantage Yas has as the spouse of a citizen is he won't be put on a quota list for immigrants. He does have to have a police report from every district he's lived in since he was 16. He does have to have a clearance from the FBI since he's lived in the US. He does have to have a complete physical, including and specifically testing for TB, syphilis, AIDS, mental defect, drug addiction, chronic alcoholism and sexual deviation (I have no idea how they test for this one). The whole process will take at least 3 months, so we're hoping to be back by the beginning of Feb. Remember, you heard it here first.

Covered briefly, but that brings us more or less up to date. So let's look at a few MAILING COMMENTS.....in no particular order.

Bonnie: Choosing an alternate world...do I get to stay 'me'? Do I get to pick who I am? Do I at least get to pick the social class I'm in? The trouble with taking your chances is most of the time you'll end up a peasant. No conflicts seem nice at first, but they get real boring real fast. Pern would be interesting, provided you didn't end up in a Hold. *Re your Pacific Rim map, you may be the first US company, but not the first. There's a company here that put one out in 1964, and an updated version in 1983. Nitchi Map Publishing Co., Ltd. Printed in Japan. Japan is printed in red; the other countries in pale pastels.

Greg: Talk about timely....one of my first sightseeing trips will have to be "Arizona's Hidden Treasure". I always suspected that there had to be something redeeming about Benson. * As for our JX, we never use it. It's not worth the investment to get a printer, because it's capacity is so limited.

Valli: My status here is somewhat the same as yours - "spouse of a citizen". Since I'm not a citizen, I have no family register. When we got married, there was nowhere to take my name 'from' to put 'to' Yas' register. I find it somewhat droll that his register lists him as married, but it doesn't say who (or what) he married. * It may have been a typo, but for the record, the Japanese long distance train is the 'Shinkansen' (not Shink Ansen). 'Shin' meaning 'new', 'kan' meaning 'trunk', and 'sen' meaning 'line'. So literally it is the 'new trunk line'. A little FYI - all Japanese words end in a vowel or the letter 'n'.

Well, that's all folks. The brain is shutting down. Read you soon.

Turn Left at Oblivion

an apazine for APA-TECH

Guy Consolmagno
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Easton, PA 18042

Progress on the Jesuitical front: Well, in the four months since last you heard from me, I have talked to a half dozen people, visited the Novitiate, read a dozen books about the Order and its founders, and I have high hopes that within a month or two I might be allowed to fill out an application. Like everything to do with this benighted Church, they take their time.

The Novitiate is a fabulous place. It was built in the 1920's by a devout lady who'd married lots of money; they spent over \$5 million (1920 dollars!) buying up land and building an elaborate place. It's like a monastery...in the old days, it was completely cloistered, the donor being the only woman allowed inside and that only once a year, and back then, when they took people right after high school, it was in effect a small college. Nowadays, the average age of novices is around 28, nearly everyone has a college degree and those who don't are sent to a regular college first. So the novices live in one wing for their two years, and the other wing is given over as a retreat house, open to all demoninations. The weekend I visited, there were Episcopal and Methodist groups using the place, as well as a retreat group from a Catholic college in Baltimore.

(How many of you have ever done retreats? Even if you are no way religious, it's a really worthwhile time...it's like a mini-vacation, you just go off for a weekend, think about your life and what the hell you're doing with it, and they'll have books to read or people to talk to, including your other retreatants. Some are totally unstructured, some will have occasional meetings scheduled where people will talk over various topics, and some are extremely rigidly scheduled. The big thing that Loyola, the founder of the Jesuits, came up with was his "spiritual exercises" which was a formally organized 30 day retreat, which all novices go through in the middle of their first year. It's supposed to be quite an ordeal. For instance...it is a silent retreat, as I understand it, there's no talking for 30 days.)

What do Novices do for 2 years? Apparently they spend the first 4 months in classes, then the retreat; after that, you're sent out for a month or so each to the various places where the Jesuits work, helping out in AIDS clinics, or teaching catechism, or working in an inner city parish. Terminally ill people or inner city

conditions do not frighten me nearly as much as a classroom of grade-schoolers does!

In your second year you spend more time in one project, usually something very different from what you expect to spend the rest of your time doing. With my background, I suspect I am eventually fated to teach college (and why not? I enjoy it) so it'll probably be more like social work that they'd have me do during this time.

Meanwhile, I have a spiritual advisor...he's a 75 year old retired Jesuit English professor; in amongst the spiritual talk, we discuss poetry and baseball.

I asked for an older Jesuit. One of the kindly, fatherly types I met at the novitiate, with gray in his temples and a bald pate, turns out to be a year younger than I am.

Meanwhile, here at the college: teaching is crazy. I have 66 freshmen physics students; 7 upperclassmen taking advanced electricity and magnetism; and 40 monsters, liberal arts students, the dregs of the college, taking my "Moons for Goons" course which has earned a reputation as the easiest gut science requirement course in the College. I know a bunch of the kids in this class already; I've met them over the last 2 years as they've appeared on various charges before the Student Conduct Committee! (A few years ago, there was one kid who was getting the highest marks in the class before we kicked him out of the school on various drugs and gun charges.)

Mailing Comments:

Valli: I love trains! And I wish my Italian were up to reading the articles (I took classes a while back, but have forgotten all I ever learned. With my name, too! Sigh.)

In Kenya, the train from Mombasa to the coast was quite an experience. Only 300 km, the trip would take 14 hours, leaving at 6 pm and arriving at 8 the next morning. Once the head of the train system was asked in a newspaper interview if Kenya would ever get "speed trains". This would create a problem, he pointed out. As things stand now, you arrive just on time. With speed trains, you would get there too soon! The crazy thing is, everyone understood what he meant. An overnight trip to Mombasa lets everyone sleep on the train, and arrive refreshed.

Speaking of Mombasa reminds me of another topic you raise. Because it's so hot on the coast, many of the Swahili women go topless all the time. As a result, of course, it's no big deal. Sometimes I suspect the point of clothing is not to "modestly cover" anything, but to draw attention to the secondary sexual characteristics.

By the way, how did you xerox those train pictures? The quality of the photographs is remarkable.

Crumbrunchers: To quote one of your comments, please continue to regale us with your adventures of kid-raising! It still never ceases to amaze me that people my age, and younger, are moms and dads.

Audrey's World: What is this, another contest of "Name That Heinlein"? The story of the kid captured by slavers is one of his, *Trader to the Stars* or some such title (where's the Pinkdex when I need it?) The second is another of his, in a totally unrelated universe, called *Have Spacesuit Will Travel*. Greg and I will both tell you the best part is that, after travelling to Pluto and beyond and saving the human race, the kid's fondest dream comes true—he gets admitted to MIT! Needless to say, this caused a lot of mirth in the MITSFS (especially since, for a lot of us, we could identify with the sentiment!) The third one, I can't help you on.

I got burned out on SF after too long an exposure to the MITSFS; plus, I discovered that doing real science could be just as exciting, that at its best it could be like living in a real SF novel. Plus, all they write are fantasies nowadays anyway. So, like you, I have gravitated into mysteries. For my taste, no one will ever match Dorothy L. Sayers at her best. Josephine Tey is right up there, too. I'm a sucker for the English drawing room style mysteries.

A friend of mine, Lynn Hall (another MIT grad; she's now living out in LA writing screenplays) is definitely of the hard-boiled/Jim Thompson school. His books definitely give me the creeps (which is the whole point, of course.)

To my mind, the most important ingredient in a mystery is an interesting character; the plots (which is always ridiculous) just serve to let us get to know the character. One mystery I started recently was centered on a blind man, a wonderfully complicated person. Then, about a third of the way in, it turns out he's the victim, not the detective (who was a sex-

ist jerk)! Rats. I stopped reading right there.

Transporter Rod: Congrats on your game!

Re the Greenhouse effect: Try to find a magazine called *Oceanus*, which had an entire issue (Winter '86/'87) devoted to climate. The bottom line is, the Earth's climate can (and has!) varied widely; we know some of the triggers (precession, changes in eccentricity of Earth's orbit, etc.) but not all the mechanisms, except that the quantity of CO₂ in the atmosphere is a factor. One theory says we're due for an ice age, but that the greenhouse effect will delay it for about 1,000 years.

The only certainty about the weather is, that it's always mighty unusual whether we've been having lately, isn't it?

Halfway Greg: Hope grad school is agreeing with you. Long time since I've heard from you, so that must mean you are as busy as I am!

I think it was Dan Dorn who also claimed he went to MIT because "Robert Heinlein said to". Actually, my decision to go there was based on the fact that the 'tute had weekend movies, tunnels, and the feeling that Real Things were going

on there, unlike my old school. The MITSFS didn't hurt, either. About Danny Hillis' book, his is one of those names I can drop, though in fact I think I only met him once, back when he was dating Margaret Minsky. Last I heard, Margaret was a grad student in AI back at MIT, having given up on space geology at Brown. (I swear, the peripatetic coed in *Real Genius* was based on her.)

Likewise, *Double Star* was my first Heinlein. That, and *Door into Summer*, are my favorites of his. Is there any truth to the rumor that Heinlein actually did die in the late 60's and that everything since then was really written by David Gerrold?

Finally, thank you (all) for your kind words on my impending jesuiticalness. I have to admit, I am amused by the unspoken "...but I think you're crazy" that accompanies those kind words! In fact, I don't expect to find what I'm looking for there. Rather, it is just a new staging ground for what is, after all, a lifelong search.

I leave you with an inspirational icon from my favorite lunatic, Ken Brown.



LOYOLA RENOUNCING THE WORLD

THE DEATH OF A FRESH WATER LAKE

Bonnie Jones
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Chicago, IL 60630

The Aral Sea, located in the Soviet Union, used to be the fourth largest fresh water lake in the world. It is now the sixth, and shrinking rapidly. Nearly all the water in its tributaries is being diverted for irrigation to grow cotton. The Aral Sea is located in the driest part of the Soviet Union, near Afghanistan.

A report in Science (Sept. 2, 1988) shows that the level of the Aral Sea has dropped 40 feet in the last 28 years. The surface area has dropped from 27,000 sq. mi. to 15,400 sq. mi. and continues to drop. The increase in salinity has wiped out most fish species. Toxic salts have invaded surrounding croplands and caused the desert to grow. Drinking water is threatened.

Now that this has gone public, the Soviet Politburo is discussing what to do. A program would include restrictions on water use, no more new irrigation systems and improving existing systems to reduce loss. As the situation worsens, Soviet scientists say it is necessary to divert water that currently drains into the Arctic Ocean. A system would not be ready for 10 to 15 years. Opponents of this plan, including the National Center for Atmospheric Research in Boulder, Colorado says that diverting fresh water from the Arctic could increase its salinity. Saltier water does not freeze as easily, which could diminish the Arctic ice cover and affect global climate.

Now on to cheerier news, the wedding of Keith Thorne and Kathy Ford. But first, some background information. Keith is a GTER from way back, he was APATECH's first member. I met Kathy at Michigan State University in the Geography Dept. I was persuing my Masters (still am) and she was chasing her PhD. (still is). Kathy is bright, attractive, likes science fiction and has her own computer; a great catch, right? I started dragging her to conventions, figuring one of our bright, able, painfully shy GTERS would latch on to her. If not, she could still have a good time at the convention. Well, you can probably figure out the rest.

Saturday, November 5, 1988, Keith and Kathy got married at the People's Church in East Lansing, Michigan. (No, I am not taking credit or responsibility!) I was best woman and Keith's brother Charles was best man. Other members of the wedding party were Kathy's sister, and Bill and Barry (available for parties, bar mitzvahs, etc.). Everything went smoothly and now the happy couple

can be referred to as K. Thorne squared, soon to be Dr. K Thorne squared. The fan contingency consisted of those listed above plus John Frombach, Marty Franz, Renee Sieber, Valli and Joah, Bill Lieninger and Sam Paris (he's the cute one).

Oh, by the way, Sam and I are buying a house.

Mailing comments for APATECH #61

Audrey: Sam informs me that the first book you describe is "Citizen of the Galaxy", and I know that the second is "Have Spacesuit, Will Travel", both by a fellow named Bob (Heinlein, that is). The book that I have the strongest childhood memories of is "Time for the Stars", also by the aforementioned author. We don't know the third one. Sorry.

I was impressed with your voracious reading as a child. My siblings and I could read and print before starting school, and I was several grades ahead in reading level. On those standardized tests they give in school in fourth grade, I think, my best friend and I were first and second in reading and math out of 80 students so we got to go to a gifted center one day a week. (Ah, but that's another story.) Sorry to say, I was not interested in non-fiction. I started reading all the fiction in the school library alphabetically, but that got boring, so I stuck mostly with science fiction and Nancy Drew. However, the school library and the local public library had very little science fiction. I did watch a lot of TV, but my mother will tell you that I always had 'my nose in a book'.

My favorite mystery author is Dick Francis. Before he turned to writing, he was one of the Queen's jockeys, so most of his stories have horses in there somewhere. Now, I don't much care for horses or horse stories, (I was the only girl in grammar school that didn't) but his stories are exciting and interesting. I also suggest trying Robert Ludlum and Tom Clancy.

Did you hear that "Don't Worry, Be Happy" was George Bush's campaign song! Now that makes me worry!

By the way, what is a 102 year old sporan?

Valli: I was on a topless beach in Nice, and I know what you mean. I liked not having to worry about proper top placement when laying down without straps, but I much prefer having support when I am up and walking around, especially when running. However, I forgot that the skin had not been exposed to sun in many years, and I burned them rather badly.

Annette: I seem to recall the topic of homosexuality coming up at least a year ago, but I will repeat what I wrote then. I read an article (don't ask me what it was, that was some time ago) that said that sexual preference depended upon the balance of male and female hormones in fetal development (remember, all fetuses start out female) and upon environmental and social development as well. This article went on to say that if the total population was sorted by sexual preference, 5% would be strongly homosexual, 25% would be strongly heterosexual, and the rest of us would be somewhere in the middle. We are all individuals, and many times it is circumstances that push us to one side or the other. In some middle eastern cultures, sex is not permitted before marriage, so men are allowed homosexual relationships while single. We could also talk about early sailors on long ocean voyages, men and women in prison and in concentration camps. I know these are extreme examples but it is possible that in the near future, because of overpopulation, homosexuality might be encouraged by countries that want to slow down their birth rate.

I don't agree with the holier-than-thou attitude by the 'Moral Minority' or anyone else who wants to limit my choices in behavior, dress, political or religious convictions, sexual preference, choice of friends...well, you get the idea. I think you can see that my point of view is similar to yours. Keep up the good work, and if I catch you thinking otherwise, I'll turn you over to Big Brother!

Its odd that you should mention time travel. Are you sure you weren't at the Bill and Barry Show at Conclave?

In Cartography, we want to use fractals to simulate natural looking coastlines when printing computer maps that have few data points.

Greg: I liked the maps. What mapping program did you use to create them? Or did you write it yourself?

My job is going fine. We are still hard at work on the new children's atlas. We have most of the maps and graphs in some stage of completion, but none finalized. It just came down from above (the marketing committee) that after one year into the project, and 7 months left, it has been decided that the colors on our political maps don't have enough kick! (They are not sure what they mean by that, just that they have to be changed. Of course, we still have to keep our deadlines.) You see, it has been a convention to use bright colors on children's maps. It doesn't seem to matter if kids actually like bright colors, those aren't the people that buy our products. What counts is whether the teachers, principals, school boards and most important, our sales reps like the maps. These people don't want something new and innovative, they want what everybody else has.

Let me give you another example of this. National Geographic Society just announced that it is changing the projection it uses for its world maps from the Van der Gritten (the one that we use) to the Robinson (the one that Rand McNally uses. They are our main competition.) This has put everyone into a tizzy, from the President on down. We had to delay work on several projects while they decided what to do. We are not going to through out our old maps, some of our best sellers, but we are going to have to add a Robinson world map to our line. A new line based on Robinson will be developed and then the old maps faded out. Also the world map in the Atlas will have to be totally redone! We have been working overtime for the last few months because we lost time to other 'emergency' projects. We were almost caught up until this happened. Now I think we will be on overtime till it is finished! I expect that by the end of the project, everyone in the lab will be working on the atlas. I bet you'll never ask me how work is going ever again!

Rod: re yr ct me: I didn't think anyone made micro-film disk typesetters anymore! Try using spray adhesive instead of wax. It holds better but you can't move it once it is down.

ED SULLIVAN, BERT PARKS, AND OTHER MCS
another APA-TECH mini-zine from Barry Gehm.

All my fannish writing time is going to *PYRO*, but I don't want to slight APA-TECH completely, so here are some mailing comments for the last two issues.

#60 #60 #60 #60 #60 #60 #60 #60 #60 #60 #60 #60 #60 #60 #60 #60
Susannah Taking along a few children lets you "do" the National Air and Space Museum in less than an hour? I wish I'd had one along when I went to the San Diego Aerospace Museum with Bill and Greg. It probably would have balanced things out. (I. e., we could have done the *gift shop* in under an hour.)

Valli You're always welcome on my couch (lcer). || I've seen the trumpeters in Count Basie's band using plumber's helpers as mutes, so it's not just Italian. At least, these guys didn't look Italian.

Joa Interesting account the Rome to Milan high-speed train. Why can't we make passenger train travel worth-while here in the US?. || As has already been revealed, Anson McDonald is Robert A. Heinlein (The A. stands for Anson; McDonald was his wife's maiden name.) As I mentioned to you at Alice's party, "Der Kreis" is not a bad title, but I'm disappointed the translator didn't go for the German equivalent of "By His Bootstraps" (or maybe he did but the editor changed it). || I admire your handling of the boor who is marrying your landlord's daughter. Usually I go too far out of my way to be "nice" to such clods, and then mutter to myself about it later. || "[Drivers from Vaud have] the phlegm of St. Bernards" is an evocative phrase, although my experience with St. Bernards has been that they are more drooly than phlegmatic.

Guy A Jesuit GTer! Is the world ready for this?

Joa 10 inch thick terra cotta walls would stop a fair amount of
wieder hard radiation, but they also increase your background dose substantially (compared to living in a wood frame building).
|| Bonnie is most qualified to comment on your isotemporal map schemes, but... The isotemporal contours (added to a standard map) seem practical, but the isotemporal projection map does not: it would be full of singularities and discontinuities, since (for instance) the travel time connecting two major cities would be smaller than that connecting many points in between the cities (because you have to go through the major cities' airports). If you restricted it to a limited number of points it might work.

Greg Quitting a job that sends you on trips to Cannes, so you can go back to *grad school*? Moving from southern California to Minneapolis? You *must* be a masochist. I bet you'd even volunteer to edit an apa! (Nah... Nobody's *that* crazy.) || The Challenger franking makes me even more dubious about NASA than Feynman's comments did. || I was startled to see the Heterodyne Boys drawing -- I suspected agents of San Diego had broken into my apartment and photographed my art collection. Another Heterodyne Boys adventure, based on that drawing, may be forthcoming, but don't hold your breath.

#61 #61 #61 #61 #61 #61 #61 #61 #61 #61 #61 #61 #61 #61 #61 #61 #61 #61

Cover Very amusing -- definitely shows the effects of graduate school on the artist's psyche. I have to quibble, though -- the official organ of General Technics is *PyroTechnics*, not APA-TECH. When *Pyro* is in hiatus, our official organ is the spleen.

GTB-III Nice map. There's a program that produces output like that on my prof's Mac II, but it omits Antarctica. Does yours?

Valli Re topless sunbathing at Rimini: Bill peeked!!! || Nice travel stories; rather a lot of Italian train frankings for those of us who don't read Italian.

Susannah How about rubber stamp pysanky? No, huh? || Re Dave leaping off a 40-foot tower: certainly not so the people below will catch him?! Did he have bungi cords tied to his ankles? Card-board boxes to land on? A pool of water? A bowl of Cap'n Crunch? (Ack!)

Gabe & The problem of getting called on to read when you're pages
Audrey ahead of everyone else certainly sounded familiar. I was the fastest reader in my class, and chronically bored during reading aloud. || Boy did you come to the right place to get early sf books identified! The first book you mention is *Citizen of the Galaxy* by Robert Heinlein. It's not a trilogy, but it does have a very segmented structure: Thorby starts out with Baslim the beggar, gets adopted by the Free Traders, then joins the Guard, finally is identified and sent home to Earth where the story ends with him regaining control of his parent's estate after a bitter proxy fight. It's well worth rereading. The second one is also a Heinlein juvenile, *Starman Jones* I think, although you or I may be mixing elements of a couple of Heinlein stories together. I'm afraid I don't recognize the third one at all. || Re mysteries: have you ever read any of Robert van Gulik's mysteries set in ancient China? || The nudists must be having a recruiting drive. Bill Higgins recently got a flyer from them, which he took as a sign from God that he was on too many mailing lists. Why is my junk mail so boring? || Am I the only member of our generation who hasn't heard "Don't Worry, Be Happy"? Should I be worried about that?

on Hume's space suit
will travel

Rod Congratulations on the game manual! || Sorry the Worldcon was such a bust for you. How does your mother conspire to give you poison ivy? || Re: aluminum pot for tea. Possibly not a good idea -- glad to hear you've replaced it. Many teas contain fairly high levels of fluoride, which promotes leaching of aluminum into the liquid.

Annette *Pyro* would be more than delighted to publish your book reviews, enabling you to benefit a much larger readership. || As you're probably aware, Alan Turing was a victim of estrogen treatment for homosexuality (legally aggravated in his case, if I remember correctly, by the underage status of his lover). His suicide is generally ascribed to depression over the accompanying physical changes..

Bill Having contributed to the reading list, I have no new comments.

Greg The "missing mass" consists of unwritten *Pyro* articles and undrawn cartoons. Write the article! || I see you do have Antarctica.

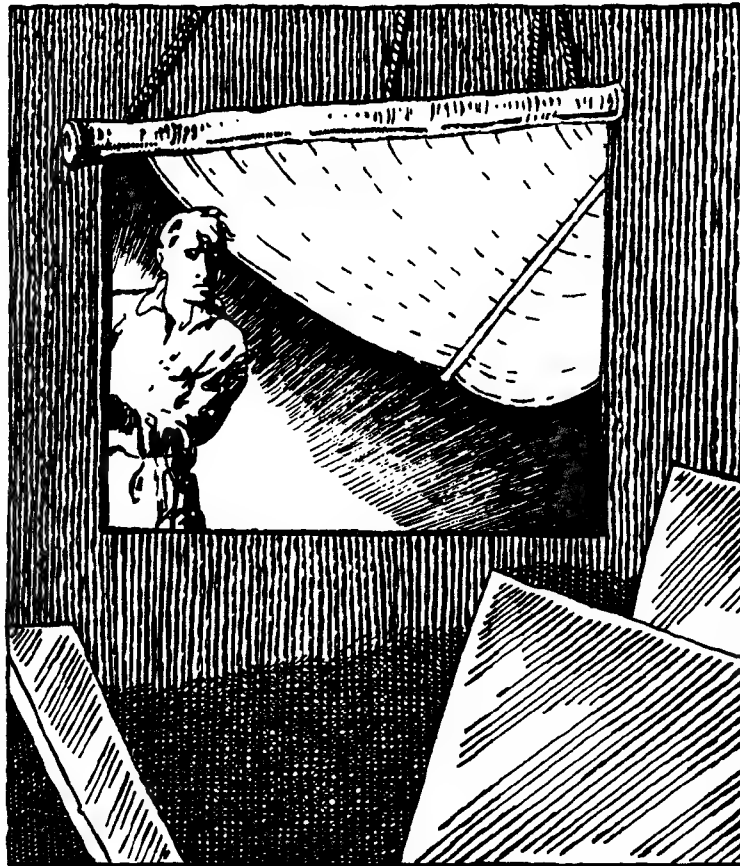
BB

THE DUST OF
A MILLION BYGONE LECTURES
SHIFTS BENEATH OUR FEET

("Dummy, that's SNOW!!")

Gregory Ruffa
1004 7th St., S.E., Apt. 103
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(612)-369-9622

(just a few short steps from
the Rodent-on-a-Stick Motel)



IT WAS HORRIBLE. FROM MY VANTAGE POINT
I COULD SEE THE STRUGGLING FIGURES
BEING CARTED INTO PROFESSOR RUFFA'S
QUANTUM COSMOLOGY TALK

When I started letting folks back in San Diego know that I was moving to Minnesota, a number of them responded simply, "It's cold." I wish to go on record in saying that it is **not** all that cold here. It compares favorably with Charon in the summertime, although the driving is somewhat more challenging here. I'm sure I'll enjoy it even more once the atmosphere sublimates again.

We must near the flapping end of the jet stream or something: winter seems to approach in waves. We were still having days in the 60s near the end of October, then we'd have a couple in the 40s, the temperature would climb back up into the 50s, drop into the 30s, and so on. I went off to dinner on Thanksgiving Day in my raincoat because it was 51° and way too warm for the winter coat. Then it snowed Saturday and Sunday. This week, it was 44° on Monday, then it dropped into the 20s by Thursday; it gets to around zero at night now, **not** counting the wind-chill. I kept telling myself I can handle it -- after all, I **have** spent most of my life in places where it gets cold in the winter. Then I remember that this is late autumn...

The fall quarter was put to rest this week with the traditional ritual of final exams. The last two weeks of the galactic astronomy course was the "exam," so to speak. The undergraduates had to write term papers, while the graduate students were required to prepare twenty-minute presentations on selected topics. I spent Thanksgiving weekend reading through a two-foot-high stack of books (no, mercifully **not** every page) to assemble as much relevant material as possible on "The Missing Mass Problem in the Galaxy." It turned out to be horrific overkill. I was the sole presentation on the last day of class and used up fifty of my twenty minutes (and I was rushing at that). I'll prepare a tolerable revision of it for **Pyro**. My statistical mechanics course went as well as could be expected. It was a good course and I could even do most of the assignments, but the instructor has a penchant for devising **clever** exam problems. Some of them were the kind you couldn't quite solve in the allotted time, but could take home, think about a little more, and write out the answer. The classical mechanics class went **only** as well as I expected, which is saying little. I'm sure the professor is a fine human being, but is **no** teacher. Besides his almost complete lack of lecture technique, he infrequently discussed solutions to homework problems, only sketched solutions when he **did** provide same, and blasted through about the last half of the material in the last third of the quarter. He also did that which I disapprove the most of, which is to present little more than what is **already** in the book and to discuss concepts and theory without providing examples. (If I already knew how to solve these problems, I wouldn't have enrolled in this course; if I wanted to study pure abstractions, I would have joined the philosophy department.) At the moment, I have **no** idea what grade I'm going to get. I can't worry about it anymore: I'm going to just keep trying to learn the stuff and start getting ready for next quarter. In three weeks, I'll be starting in on extragalactic astronomy (the stuff beyond the Milky Way, but not the whole Universe yet), the other quarter of statistical mechanics, and the second quarter of classical physics, with special relativity and electrodynamics. Hot dog, let's eat!!

The excessive research for my presentation wasn't really wasted. I'm trying to get an idea of where things stand in cosmological research, so I can start thinking about a thesis topic. I'm going to try to start getting involved in research next quarter with one of the people involved in computational work. He suggested a bunch of things to read, which I'm now getting into. I'll let you know when this starts to take on what could be called a direction...

One of the public relations things that the Department does is to produce a telephonic presentation called "Minnesota Starwatch" jointly with WCCO, one of the local stations. Various people in the Astronomy Department write the scripts and one of the station announcers does the reading. I'll be preparing the material about every other month, beginning with this one; if you're actually curious to hear this, call (612)-624-2001. (He doesn't read it exactly as I wrote it, but I'm also going to have to learn to write it a bit closer to his style...)

I've made contact with the local space interest groups here to offer talks and maybe a little assistance. (I don't wish to become too involved, since I really would like to get my degree.) The professional chapter of AIAA doesn't appear to be very active here, but the student chapter is fairly large, since Minnesota has a pretty big aerospace engineering department (GD likes it: they do a lot of recruiting here; at least five or six of the people in Trajectory and Performance went here). I may be giving them a talk during the next quarter or two. The Students for the Exploration and Development of Space chapter meets fairly regularly and has conducted significant events. This past April, they held "Student Space Week," which included talks by minor luminaries of the space programs here, in Europe, and in Japan and by a guest cosmonaut. They are already working on plans for a similar event for August of 1990.

Keith Thorne, once of these pages (in fact, APA-TECH member #1), was up here for a day or so to give a colloquium on his doctoral thesis work down at Fermilab. He is re-measuring the lifetimes and other particulars of certain heavy subatomic particles (the lambdas and the xi or cascade); he is doing this to about an order of magnitude better precision than the last time it was done about fifteen years ago. The results have some bearing on predictions made by the theory of the "weak force." He had a lot of interesting things to say about experimental design for this kind of work in high-energy physics (like how pions ricocheting off a building wall and back into your detectors can mess up the data). Unfortunately, the audience was almost all the theorist grad students, because most of the experimentalist faculty and students were off to The Mine, where Minnesota has a number of passive detection experiments, showing off their work (i.e., defending it) to government visitors. It looks like Keith should be picking up his degree next year (at last!).

Meanwhile, we theorist types only have to worry about busting our pencil points or the supercomputer being down. Sunday morning (the 11th), I'm off to Dallas for the Fourteenth Texas Symposium on Relativistic Astrophysics. It's their 25th anniversary, so it should be fun. This series started off as a biennial event back in '63, but, by the late 1970s, the astrophysicists and particle physicists and other folks found they had so much going on that they had to start meeting **every** year. The meetings have also been travelling around a bit, so that recently the "Texas" Symposium has been at Fermilab and Jerusalem; they decided to bring it home for the Silver Anniversary. The people who come deal with those places where high-energy physics or general relativity touch on processes of interest in astrophysics, from the scale of a single star (pulsars, black holes, etc.) on up to The Cosmos (or even "superspace!"). Minnesota gives discretionary funds to its departments to spend on graduate students. Our graduate advisor thought my going to this was a good enough idea to suggest that I submit a budget. Apparently, there were sufficiently few requests for money that the Department is picking up the tab for practically all my expenses. So I'm on my way there before going on to visit my folks for a couple weeks. Then it's right back here for classes on January 3rd.

I still hear some news from friends back at GD, though I'll have to get on the phone with them now that I have the time. Work continues to pour in to Space Systems Division, but apparently things are getting a little rocky at Flight Mechanics. My former superior defected to the "Blue Building." Just as "CP" stands for "Century Park" (or the "Crystal Palace," as we like to call it), "BB" is the "Balboa Building," a new blue glass-curtain office building that the Commercial Launch Services people have taken over a floor of. CLS just loves to make headaches for us, since they're out there selling, selling, selling, but the analyst pool isn't expanding. I'm told that we now **do** have a launch sold for December of 1989, which gives us about one year to get a new Atlas-I built, checked out, and on the pad ("Can we do it, men?" "*gak*"). Of course, Eutelsat-II is still going ahead for March of 1990 and the other quarterly launch are falling into line. In fact, I'm told one of my former co-workers (once involved with the secret Titan/Centaur work)

is on his way to France soon for a "technical interchange meeting" with Eutelsat (that is, he has **my** old job). Elsewhere, on the Advanced Launch System front, nothing is happening. Since Congress decided to let the next President decide what to do about SDI, money has been cut off on related programs. So all the Crystal Palace engineers involved with ALS are marking time. (Given the outcome of the election, I suspect they'll be hard at work again soon...)

It was nice to see folks again down at Windycon last month. I met new GTer Anders David Wilson and **all** of the Trembleys for the first time. There just wasn't enough time to really get caught up with everybody (so I'll just have to come visit again!). The folks I spent the most time with were Bill Leininger and Gretchen van Dorn (as we wandered through the innards of that behemoth, the Woodfield Mall), the Wilsons, Brad Berg and John Nine (at Alice Bentley and Greg Ketter's Party and Big Book Give-away: if you want lotsa people to come to your room, tell them there's free food and books), and Barry and Jo. I plan to come to Capricon in February, if they'll send me a flyer (hint) [I'll even give a talk for FREE, just tell me where to sign up!]. The big convention here is downtown at the end of spring break, so I hardly have to exert myself for that.

Other than that, most of my coming travels will be largely professional. I plan to go to the American Astronomical Society meeting in Ann Arbor next June (maybe I'll even have something to present?). I'm also going to try to get to my AIAA Technical Committee meetings next May in Washington and next August in Pasadena (just around the time of the Voyager 2 Neptune encounter). I also expect to get to the International Space Development Conference in Chicago during Memorial Day weekend, although that is right at the last week of spring classes (I'll just have to avoid an end-of-the-quarter crisis, ha ha...)

I have to wind this up and run to the copy shop and the post office. The franking this time are an article which appeared in **The Minnesota Daily** ("the country's best student newspaper," we won't mention the semi-pro ringers) on Dreamhaven, Greg Ketter's store here in Dinkytown (where the Chicago Trib article on Ketter and Bentley's store in Chicago is hanging), a piece from the **Star-Tribune**, presumably, on what people **prefer** to call the Reagan Hi-NRG Donut, a list of high-temperature superconductor fanzines, a page written by Dr. Bruce Cordell for **The Orbiteer**, the GD Space Systems Division house organ (with catcalls added by friend and former co-worker Bob Happersett), and an article from the November 1987 **Atlantic Monthly** chosen with Annette and Kiran Wagle (late of the APA) in mind.

Have a good Holiday Season! If I get to Capricon, we'll collate #63 in Chicago. As Paul Erdős would paraphrase Barry Gehm, don't leave.

Dreamhaven bookstore peddles stuff dreams are made of

By **Lori Janies**
Staff Reporter

Walking through the Dreamhaven Bookstore in Dinkytown is a lot like strolling through Stephen King's anxiety closet.

Giant hairy spiders and oozing, mucus-coated creatures from uncharted galaxies mingle with the possibly equally frightening forms of George Bush and Bill the Cat.

The store is Dinkytown's equivalent of an intergalactic flea market.

The small shop is packed to the ceiling with rare and not-so-rare comic books, science fiction, fantasy and horror literature, and fantastical and other-worldly merchandise and artwork.

"I do a lot of searching," said Greg Ketter, Dreamhaven's owner. "I find the odd items nobody else has."

Ketter said that for a bookstore to survive on a campus that is as inundated with bookstores as the University's, it must offer unique merchandise.

Ketter said he travels throughout the United States and Europe to find merchandise. On Ketter's last trip, to England, he discovered six books that were so valuable they paid for his trip. "But," he said, "it's usually much harder to make a buck."

Among the "odd items" one can get at Dreamhaven are a signed and numbered leather-bound edition of Stephen King's *Skeleton Crew* for \$500, or a package of Iran/Contra Scandal Trading Cards for \$7.95.

Dreamhaven has been a part of the Dinkytown community since 1982, when it occupied a shop above Gray's Campus Drug. Because the shop was too small and hard-to-find, Ketter moved the store to its present location at 1300 Fourth St. S.E.

"It was either give (the store) up or expand it," Ketter said.

Peder Wagtskjold, Dreamha-

ven's wholesale manager, said the store's diverse merchandise leads to an equally diverse clientele.

On any given day, Wagtskjold said, he might see "people (buying) books on magic, or little old grandmothers who come in and want some science fiction to read on the bus to Duluth."

Pat Lee, an art student at the Minneapolis College of Art and Design, went to Dreamhaven to buy H.R. Giger's Japanese edition of his art book *Giger's Necronomicon*. Giger is the Swiss artist who created the art design for the movie *Alien*.

Lee said that Giger's artwork is "inspirational" to him. "This is very rare. This is a Christmas present for myself," he added.

Ketter said Dreamhaven appeals to people because employees are able to "do a lot of personal recommendations on books."

"Generally, everybody we've had (working) here was a customer first," Ketter said.

Alan Payne, Dreamhaven's retail manager, is one such customer-turned-employee. Payne specializes in comic books.

"It's becoming much more fashionable to read comics," Payne said, adding that the age group of comic-book readers ranges from ages 6 to 60, with the number of older readers continually increasing.

Payne said the demand for science fiction and fantasy literature is also increasing.

"So much of what was (once) science fiction is now fact, so reading a book of science fiction is like looking into the future," he said.

It's big, it's bad, it's Super Clyde

Its official name is the **Ronald Reagan Center for High Energy Physics**, but a newspaper contest has yielded a friendlier, Texas-style moniker for the superconducting super collider — **Super Clyde**.

"It's easy to say, and still, to the ear, it sounds like Super C'lider," said **Jewel P. Clark, 72**, of Garland, Texas, whose winning entry was among more than 1,000 suggestions received by the **Dallas Morning News**.

Receiving honorable mention were the names **Armadillotron**, the **Big Bang Thang**, **Big Texelerator**, **Proton-B-Que** and **Waxasmashie**. **Supercolliderfragilisticexpialidocious** also was popular.

Clark's prizes include a year's supply of **Atomic Fireballs** candy, a junior scientist microscope and two passes to a science museum. The \$4.4 billion underground atom smasher — the world's biggest and most powerful — will be built in **Waxahachie**, south of Dallas.

The 53-mile tunnel will take eight years to build.

MARS

may be in our lifetime

The greatest human adventure of our time — the manned exploration of Mars — will soon become the catalyst for a new course of human evolution in space. In addition to spectacular adventure, Mars offers mankind important new scientific knowledge, a compelling stimulus for technological growth, potentially great economic return, biological and cultural security, and a profound opportunity for the evolution of human civilization and consciousness into the cosmos.

by Dr. Bruce M. Cordell

Establishing civilization on Mars will require an advanced space infrastructure including an Advanced Launch System and advanced Shuttle, the Space Station, Space Transfer Vehicles, and Mars orbital and surface facilities. These and other infrastructure elements are either planned or under development by NASA. Indeed, *there are no major technological obstacles to our conquest of Mars.*

Although Mars programs will not be cheap, current estimates for the first manned Mars mission amount to an annual cost of less than \$10 per person in the United States for a 12-year program — equivalent to one less pizza per person each year! Indeed the price can be reduced even further by going *first* to the moons of Mars — Phobos and Deimos, internationalizing the mission to share costs, and/or utilizing resource synergisms between operations on Phobos, the Lunar surface and low earth orbit. Current work in the Mars/Lunar Advanced Research Study (MARS) programs at Space Systems has focused on the last area.

It's clear that large-scale human operations in deep space will require use of space resources for life support, propellants, and other purposes. One of our MARS studies has attempted to identify which site — Moon, Phobos/

Deimos, Mars surface, or Earth — would be the best fuel production location from which to support anticipated operations in deep space and low Earth orbit.

As reported recently at the International Astronautical Federation Congress in India, Phobos and Deimos compare favorably with even the Moon as the best future cosmic gas station for thirsty vehicles in Earth-Moon space. This is partly because the Moon is lacking in light elements and totally dry (lunar rocks returned by Apollo

astronauts contained absolutely no lunar water), while Phobos and Deimos have densities and characteristics similar to carbonaceous meteorites with up to 20% water. Thus, hydrogen fuel would have to be expensively imported from Earth to complement the oxygen which could be extracted from lunar surface rocks and used for propellants.

As an alternative, we have proposed that hydrogen and oxygen from Phobos be retrieved to the Moon or low Earth orbit to support lunar industrialization or operations near Earth. This is initially reasonable because every two years, Phobos and Deimos are more accessible from low earth orbit than the lunar surface! Preliminary cost analysis reveals that the Phobos scenario could

easily save the cost of the first couple of manned Phobos missions in only one decade of continuous operations (for reasonable post-2000 Earth launch costs).

What will greet us upon our arrival at Mars? Perhaps the most spectacular piece of extraterrestrial real estate in the solar system! And the best part of the bargain is that Mars is very Earth-like and practically crying out for humans to transform it into Earth II. *— oh really, Bruce*

For example, although the Martian atmosphere is cold and thin, we can use simple techniques to extract water and breathable air from it. In addition to water, Mars has all the chemical

substances required for humans to establish permanent bases with relative ease; thus no costly imports are required.

Greenhouses would soon dot the red planet's surface as the burgeoning Martian civilization evolved. Studies of the Martian atmosphere would contribute to the riddles of the greenhouse effect and future ice ages on Earth. And,

gently lurking within Mars' red sands might be the remnants of an early alien fossil, preserved from a more clement time in Mars' history millions, maybe billions, of years before.

When will this magnificent Mars vision occur? NASA Headquarters is currently conducting a planning exercise which will culminate in a decision on which human space venture — lunar or Mars outpost — should initially be pursued.

This Pathfinder decision will occur between 1990 and 1992 and be followed by design and hardware programs in the mid-to-late 1990s. We should be well on our way to Mars by 2001.

Indeed, Mars may be in our lifetime.



Painting by Michael Carroll

I'm not going to Mars!



November 4, 1988

Third Quarter Financial Report

by Charlie Lloyd
Division Vice President and Controller

Through the first three quarters of 1988, division sales are \$191 million which is \$24 million under the 1988 Operating Plan projections. This is primarily due to the delayed startup and funding constraints on the Space Station Power program and the Advanced Launch System contract.

Although the division sales are lower than planned, our backlog at year-end of \$1.1 billion shows strong long-term growth for our business.

Third Quarter Year-to-Date Status

Sales	\$191 M
Net Earnings (Loss)	(24) M
Pretax Funds Generated (Used)	(117) M
Indirect Costs	133 M

The division's pretax funds used for 1988 are estimated at \$188 million. This investment reflects the division's commitment to procure and manufacture 62 Atlas I/ II/ IIa vehicles.

Indirect costs for the division are forecasted at \$133 million for 1988 which is \$3 million under our revised Operating Plan goal. The division goal was updated to reflect the MLV II award and the division commitment to increase the Atlas manufacturing base from 18 to 62 vehicles.

The division's total employment is projected to be between 4100 and 4300 by the end of the year. Our 1989 employment level is estimated to be around 4800 employees.

Plant Services Bus Schedule

Since our facilities are spread out across the San Diego area, transportation to and from other locations is an important issue.

The Transportation Department has revised its bus schedule to meet Space Systems needs and to encourage bus use.

If you have any doubts about riding the bus, you should first know that all buses are air-conditioned and that the high back seats make for a comfortable ride.

Questions about the bus service can be directed to the dispatcher at 75800.

KM = Kearny Mesa, Bldg 5, SW corner
and gate between Bldg 25 & 26

CP = Century Park in front of building 3

VP = Viewpoint Plaza in front of building 2

DB = Daley Building

BB = Balboa Building

Depart: KM 25 & 26 via 5, CP, DB, VP, BB
Times: 7:10, 8:00, 8:50, 9:50, 10:40, 11:30,
1:05, 2:05

Depart: KM 5 via CP, DB, VP, BB
Times: 7:15, 8:05, 8:55, 9:55, 10:45, 11:35,
1:10, 2:10

Depart: CP via DB, VP, BB
Times: 7:25, 8:15, 9:05, 10:05, 10:55, 11:45,
1:20, 2:20

Depart: DB via VP, BB
Times: 7:35, 8:25, 9:15, 10:15, 11:05, 11:55,
1:30, 2:30

Depart: VP via BB
Times: 7:45, 8:35, 9:25, 10:25, 11:15, 12:05,
1:40, 2:40

Depart: BB to KM 25 & 26
Times: 7:45, 8:40, 9:30, 10:30, 11:20, 12:10,
1:45, 2:45

Smokers Take a Day Off

Space Systems will be asking employees to quit effective November 17 — they aren't, however, going out of business. They just want employees who smoke to put their tobacco habit "out of business" for one day.

Space Systems, like hundreds of other companies around the country, is urging people to take part in the American Cancer Society's Great American Smokeout on Thursday, November 17.

The Smokeout, a 24-hour moratorium from smoking, is observed annually on the third Thursday of November. This year marks the twelfth anniversary of the "day off" from smoking.

Smokeout Central is the headquarters for information, events, and drawings in San Diego. Offices are located at the

Fashion Valley Mall.

Pledges to support a smokefree community are being made by both smokers and nonsmokers. If you'd like to sign up your support, pledge cards are available through Bill DeGarmo, manager of Safety & Health, on the second floor of KM building 26.

"Our employees are one of our primary concerns," said Bernie Kulchin, vice president of Human Resources, "so we appreciate this opportunity to encourage good health. The Smokeout is a light-hearted, good-natured campaign, not an 'us against them' type thing."

According to a Gallup survey, last year's Smokeout convinced 19.6 million American smokers to make an attempt at a "day off" from smoking.

Hot from the laboratory

Robert M. Hazen

Publishers of newsletters have reacted swiftly to meet the demand for information on developments in high-temperature superconductivity. What have these publications got to offer?

THE 1986 revelation of high-temperature superconductivity was unique in the history of materials science, and of publishing. Journals quickly altered their review procedures, and even changed formats, in order to accommodate the ensuing flood of reports and the need for speed. New journals devoted exclusively to high-temperature superconductivity appeared along with dozens of special high- T_c volumes and conference reports. But the normal scientific media have proved too slow for superconductor research circles. In this frenetically competitive atmosphere, knowledge is the most prized commodity, and researchers will gladly pay to get it.

Enter the superconductivity newsletters. Has a publishing niche ever been filled so quickly? Within six weeks of the 'Woodstock of Physics' on 18 March 1987 (the last-minute, all-night superconductivity session at the American Physical Society meeting in New York), the first newsletter rolled off the presses. By the end of the summer eight more had been launched. The race for publishing dollars has paralleled that for higher critical temperatures.

This article reviews most of the newsletter-style periodicals devoted to superconductor science and technology. These publications are distinguished by inclusion of news stories, review articles, lists of work not yet published or behind-the-scenes reports of superconductor research laboratories (for which read gossip), rather than original scientific reports.

The nine titles surveyed are summarized in the table overleaf, which gives the

Supercurrents



The Superconductivity Magazine



vital statistics and brief comments on each of them. Taken as a group, these publications serve a useful — perhaps vital — role by providing a rapid international communications medium. But no one needs to scan more than two or three of them. The question is, which ones?

Without doubt first prize goes to *High- T_c Update*, published by the United States Department of Energy under contract with the Ames Laboratory, Iowa State University. This 8–16-page biweekly newsletter has become the international clearing house for superconductivity preprints. In addition to listing as many as 100 manuscript titles per issue, it features

news stories on the most significant advances and provides space for meeting and product announcements. Best of all, *High- T_c Update* is free! All superconductor researchers should be on its mailing list — the newsletter is available electronically as well as in printed form — and should send their preprints (and thanks) to the editor, Ellen O. Feinberg.

Of those you have to pay for, I found the Washington-based *Superconductor Week* to be the best bet for researchers. This eight-page, weekly publication is devoted exclusively to developments in superconductivity and stands out among commercial newsletters by providing not



only rapid but usually cautious coverage of both high- T_c science and technology. This was one of the first publications to report on the record-setting bismuth and thallium superconductors early in 1988, for example, and its news stories have appeared as formal citations in major physics journals. *Superconductor Week* carefully labels unconfirmed rumours as such, and the editorial staff do their homework, attending the main scientific meetings and maintaining close contact with laboratories around the world. The articles are written in a readable yet non-nonsense journalistic style, though I find the habit of treating strings of individual sentences as separate paragraphs rather distracting. I understand that it comes in electronic form, on NewsNet.

Superconductivity News (not to be confused with *Superconductor News*) is a close second, with particularly strong reporting of high- T_c conferences. A thorough job is usually done in digging out news and analysing the scientific and technological implications. Monthly issues are supplemented by news updates for important stories. The regular "Handbook" feature provides a comprehensive listing of superconductivity events and products in a concise and efficient format. Subediting is slack at times, and the writing style is a bit too cute for my taste, with dozens of self references to "SN" in every issue. Remarks such as "SN hopes researchers will invent an elevated

transition temperature superconductor made from commonly available elements" are space fillers, not news.

New Technology Week, with good coverage of commercial aspects of superconductors and other electronic materials, is another option. Here the emphasis is more on government and corporate politics, rather than the science of materials. In most of the weekly 12-page issues two or more pages of superconductor news are integrated with other features. Competition between the United States and Japan, industrial research strategies and relevant Congressional legislation are typical fare.

Superconductor Week

The overall tone is rather pessimistic, with headlines such as "National Labs Struggle with Technology Transfer" and "U.S. Ceramics Effort Pulling up the Rear". But if materials policy is your concern then *New Technology Week* is a valuable resource. Both *Superconductor Week* and *New Technology Week* go to press late on Friday and appear on Monday morning, thus ensuring the fastest possible coverage of developments.

Of the remaining periodicals, my favourite is *Supercurrents*. Launched in January 1988, this glossy monthly is the most stylish of the lot. Donn Forbes, the editor, seems determined to produce a publication that combines timely features with lasting archival value. Of special interest are interviews with leading researchers (recent issues have featured Art Sleight, Shoji Tanaka and Brian Maple, for example). Well-illustrated review articles on the science of superconductivity and realistic assessments of potential applications add to the non-ephemeral aura. *Supercurrents* will never be the first to report on high- T_c breakthroughs, but it is a publication that materials research libraries should seriously consider adding to their acquisitions list.

It will be years before superconductivity researchers can settle down to a more sedate and normal routine. Meanwhile, armed with these publications, they have a reasonable hope of staying informed. □

Robert M. Hazen is in the Geophysical Laboratory, Carnegie Institution of Washington, 2801 Upton Street, NW, Washington, DC 20008, USA. He is author of *The Breakthrough: The Race for the Superconductor (Summit, 1988)*, in Britain published by Unwin Hyman under the title *Superconductors: The Breakthrough*.

• Just launched by World Scientific is the first issue of *HT News*, a free monthly newsletter which will "tend toward a more 'academic' approach", and which contains abstracts of published papers, titles and authors of forthcoming papers, conference notices and "resources information". In the United States World Scientific is at 687 Hartwell Street, Teaneck, New Jersey 07666; in Britain at PO Box 379, London N12 7JS.

Hot from the laboratory — publication details for 1988

Publication and launch date	Publisher	Issues per annum	Subscription per annum	Comments
The Cambridge Report on Superconductivity (Sept. 1987)	Rich-Gumpert Inc. 1 Kendall Square Cambridge Massachusetts 02139	12	\$245 (US), \$270 (elsewhere)	Neither timely nor cost-effective at eight pages per issue. Good coverage of the Cambridge, Massachusetts, scene, but weak on superconductor science and foreign developments.
High-T_c Update (May 1987)	Ames Laboratory/ US Dept of Energy 12 Physics Iowa State University Ames, Iowa 50011	24	Free	The Department of Energy and the editor deserve medals for this vital information clearing house. Proves you can get something for nothing — though foreign subscribers have to agree to provide preprints etc. in return.
Lets Levitate (Aug. 1987)	The Superconductor Hobby Club 1915 Zachary Drive Salt Lake City Utah 84116	6	\$30 (US)	This modest (some might say crude) six-page photo-copied newsletter is written for amateur scientists. Short features on the history, applications and recent developments in high- T_c materials are competent and low key, but they don't provide enough of an overview to justify the subscription cost!
New Technology Week (June 1987)	King Communications Group 627 National Press Building Washington, DC 20045	50	\$395	Timely coverage of corporate and government policies and politics affecting materials research and development. Superconductivity is prominently featured in the context of electronic materials. Not the best high- T_c coverage, but valuable for its overview of a variety of new materials.
Superconductivity Flash Report (Sept. 1987)	Flash Report Publishers Inc. Suite 626 Doral Plaza 155 N. Michigan Ave Chicago, Illinois 60601	24	\$345 (US), \$390 (elsewhere)	Each eight-page issue contains broad international news coverage of superconductor science and applications, but most reports are of the snippet variety. Useful as a starting point for tracking down advances in industry.
Superconductivity News (July 1987)	Superconductivity Publications Inc. Suite 2000, 65 Jackson Drive Cranford New Jersey 07016	12	\$300 (US), \$360 (elsewhere)	Twenty-page issues contain a satisfying blend of science and applications, written in an occasionally distracting, light and colloquial style. The best of the non-weekly newsletters, but not as up-to-the-minute as <i>Superconductor Week</i> .
Superconductor News (Aug. 1987)	Superconductor Applications Association 24781 Camino Villa Avenue El Toro California 92630	6	\$45 (US)	Publication of a trade association. Recent eight-page issues contain paragraph-long summaries of work at various industry and university laboratories, but little that is new or of substance. Two-page advertisements for conferences and services administered by the association are a prominent feature.
Superconductor Week (July 1987)	Atlantic Information Services 1050 17th St N.W. Suite 480 Washington, DC 20036	48	\$337 (US, pre-paid); \$357 (US, not pre-paid); add \$74 for air mail elsewhere	Best of breed. Coverage of high- T_c science and technology is rapid and conservative. Editor David Chaffee maintains an effective news balance between laboratory discoveries, corporate developments, and government policy on superconductivity.
Supercurrents (Jan. 1988)	Supercurrents PO Box 889 Belmont California 94002	12	\$60 (US)	This stylish monthly reports important high- T_c developments, along with features of lasting archival value. Interviews with leading researchers, combined with high-quality photographs, sets <i>Supercurrents</i> apart from the newsletters.

Omitted from this round-up are several closely related newsletters on materials science more generally, including *Materials and Processing Report*, *Japan Materials News*, *High-Tech Materials Alert* and *Nikkei High Tech Report*. Also excluded are three failed newsletters — *Superconductor Advisory Newsletter*, *Superconductivity Research, Development and Commercialization Report* and the ambitious and stylish monthly, *SuperConductor World Report*.

*Paul Erdős is certainly the most prolific—
and probably the most eccentric—mathematician in the world*

THE MAN WHO LOVES ONLY NUMBERS

BY PAUL HOFFMAN

IT IS DINNERTIME IN GREENBROOK, NEW JERSEY, AND Paul Erdős, seventy-four, has lost four mathematical colleagues, who are sitting fifty feet in front of him, sipping green tea. Squinting, Erdős scans the tables of the small Japanese restaurant, one arm held out to the side like a scarecrow's. He is angry with himself for letting his friends slip out of sight. His mistake was to pause at the coat check while they charged ahead. His arm is flapping wildly now, and he is coughing. "I don't understand why the SF has seen fit to send me a cold," he wheezes. (The SF is the Supreme Fascist, the Number-One Guy Up There, God, who is always tormenting Erdős by hiding his glasses, stealing his Hungarian passport, or, worse yet, keeping to Himself the elegant solutions to all sorts of intriguing mathematical problems.) "The SF created us to enjoy our suffering," Erdős says. "The sooner we die, the sooner we defy His plans."

Erdős still does not see his friends, but his anger dissipates—his arm drops to his side—as he hears the high-pitched squeal of a small boy, who is dining with his parents. "An epsilon!" Erdős says. (*Epsilon* is Erdős's word for a small child; in mathematics that Greek letter is used to represent small quantities.) Erdős moves slowly toward the child, navigating not so much by sight as by the sound of the boy's voice. "Hello," he says, as he reaches into his ratty gray overcoat and extracts a bottle of Benzedrine. He tosses the bottle into the air and catches it at the last second. The epsilon is not at all amused, but, perhaps to be polite, his parents make a big production of applauding. Erdős repeats the trick a few more times, and then he is rescued by one of his confederates, Ronald Graham, the director of the Mathematical Sciences Research Center at AT&T Bell Laboratories, who calls him over to the table where he and Erdős's other friends are waiting.

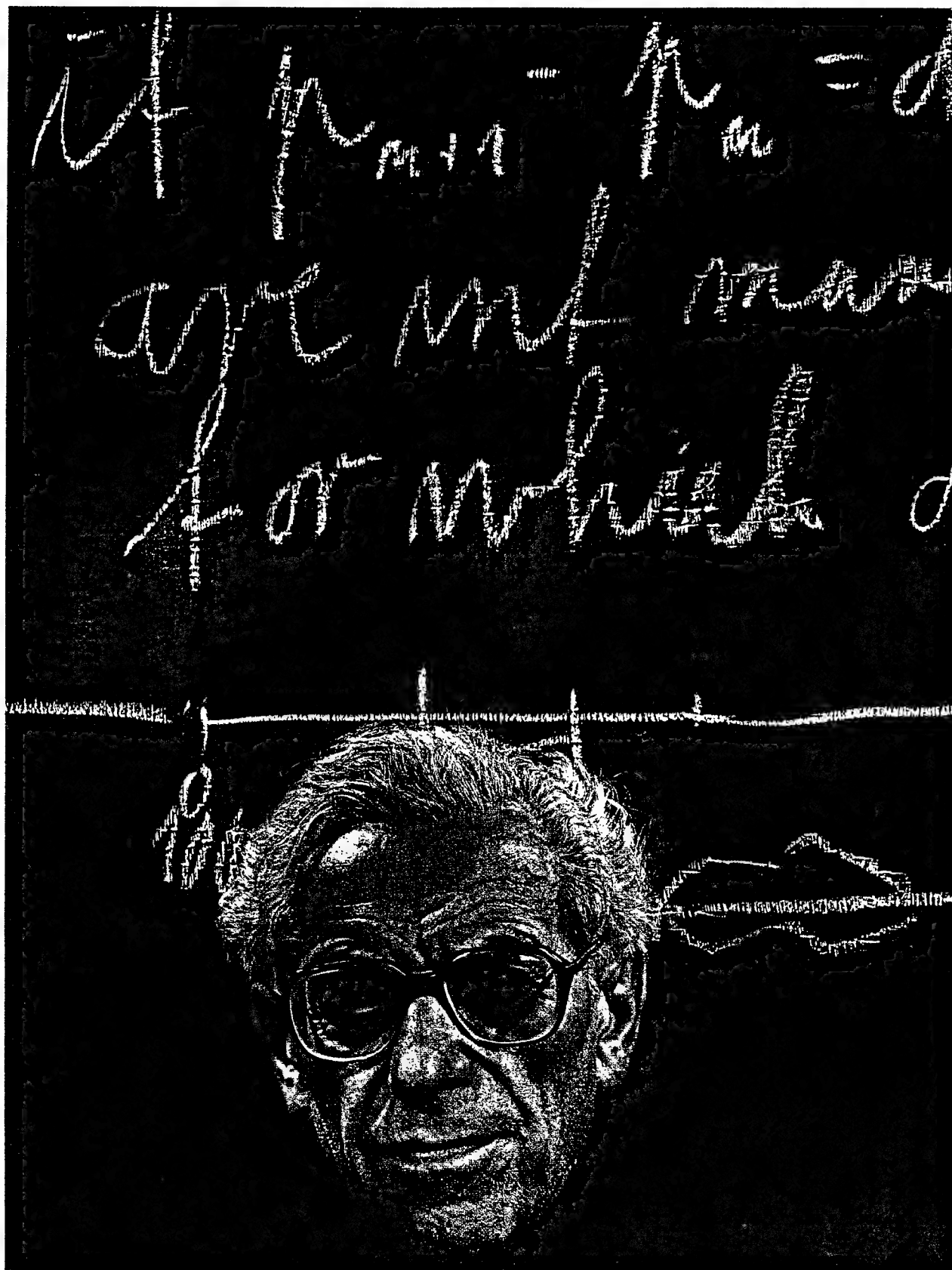
The waitress arrives, and Erdős, after inquiring about each item on the long menu, orders fried squid balls. While the waitress takes the rest of the orders, Erdős turns over his placemat and draws a tiny sketch vaguely resembling a rocket passing through a hula hoop. His four dining companions lean forward to get a better view of the world's most prolific mathematician plying his craft. "There are still many edges that will destroy chromatic number three," Erdős says. "This edge destroys bipartiteness." With that pronouncement Erdős closes his eyes and seems to fall asleep.

MATHEMATICIANS, UNLIKE OTHER SCIENTISTS, REQUIRE no laboratory equipment. A Japanese restaurant is as good a place as any to do mathematics. Mathematicians need only peace of mind and, occasionally, paper and pencil. "That's the beauty of it," Graham says. "You can lie back, close your eyes, and work. Who knows what problem Paul's thinking about now?"

Erdős has thought about more problems than any other mathematician in history. He has written or co-authored more than 1,000 papers, many of them monumental, and all of them substantial. In the past year alone he has published fifty papers, which is more than most good mathematicians write in a lifetime. He has shown that mathematics is not just a young man's game.

Erdős (pronounced "air-dish") has structured his life to maximize the amount of time he has for mathematics. He has no wife or children, no job, no hobbies, not even a home, to tie him down. He lives out of a shabby suitcase and a drab orange plastic bag from Centrum Aruhaz ("Central Warehouse"), a large department store in Budapest. In a never-ending search for good mathematical problems and fresh mathematical talent, Erdős crisscrosses four continents at a frenzied pace, moving from one university or research center to the next. His *modus operandi* is to show up on the doorstep of an esteemed mathematician, declare, "My brain is open," work with his host for a day or two, until he's bored or his host is run down, and then move on to another home. Erdős's motto is not "Other cities, other maidens" but "Another roof, another proof." He has done mathematics since he was three, but for the past sixteen years, since the death of his mother, he has put in nineteen-hour days, keeping himself fortified with ten to twenty milligrams of Benzedrine or Ritalin, strong espresso, and caffeine tablets. "A mathematician," Erdős is fond of saying, "is a machine for turning coffee into theorems." When friends urge him to slow down, he always has the same response: "There'll be plenty of time to rest in the grave."

Erdős lets nothing stand in the way of mathematical progress. When the name of a colleague in California comes up at breakfast in New Jersey, Erdős remembers a mathematical result he wants to share with him. He heads toward the phone and starts to dial. His host interrupts him, pointing out that it's 5:00 A.M. on the West Coast. "Good," Erdős says, "that means he'll be home." When



challenged further in situations like this, Erdős has been known to respond, "Louis the Fourteenth said, 'I am the state'; Trotsky could have said, 'I am society'; and I say, 'I am reality.'" No one who knows him would argue. "Erdős has a childlike tendency to make his reality overtake yours," a friend says. "And he's not an easy houseguest. But we all want him around—for his mind. We all save problems up for him." To communicate with Erdős you must learn his language—not just "the SF" and "epsilon" but also "bosses" (women), "slaves" (men), "captured" (married), "liberated" (divorced), "recaptured" (remarried), "noise" (music), "poison" (alcohol), "preaching" (giving a mathematics lecture), "Sam" (the United States), and "Joe" (the Soviet Union). When he says someone has "died," Erdős means that the person has stopped doing mathematics. When he says someone has "left," the person has died.

At five foot six, 130 pounds, Erdős has the wizened, cadaverous look of a drug addict, but friends insist that he was frail and gaunt long before he started taking amphetamines. His hair is white, and corkscrew-shaped whiskers shoot out at odd angles from his face. He usually wears a gray pin-striped jacket, dark trousers, a red or mustard shirt or pajama top, and peculiar pockmarked Hungarian leather shoes, made specially for his flat feet and weak tendons. His whole wardrobe fits into his one small suitcase, with plenty of room left for his dinosaur of a radio. He has so few clothes that his hosts find themselves washing his socks and underwear several times a week. "He could buy more," one of his colleagues says, "or he could wash them himself. I mean, it takes zero IQ to learn how to operate a washing machine." But if it's not mathematics, Erdős won't be bothered. "Some French socialist said that private property was theft," Erdős recalls. "I say that private property is a nuisance."

All of his clothes, including his socks and custom-made underwear, are silk, because he has an undiagnosed skin condition that is aggravated by other kinds of fabric. He doesn't like people to touch him. If you extend your hand, he won't shake it. Instead, he limply flops his hand on top of yours. "He hates it if I kiss him," says Magda Fredro, sixty-six, a first cousin who is otherwise very close to him. "And he washes his hands fifty times a day. He gets water everywhere. It's hell on the bathroom floor."

Although Erdős avoids physical intimacy, and has apparently always been celibate, he is friendly and compassionate. "He exists on a web of trust," says Aaron Meyerowitz, a mathematician at Florida Atlantic University. "When I was a graduate student and we had never met before, I gave him a ride. I didn't know the route and asked him if he wanted to navigate with a map. He didn't want to. He just trusted that I, a total stranger, would get him there." What little money he receives in stipends or lecture fees he gives away to relatives, colleagues, or graduate students. A few years ago he won the prestigious Wolf prize, the most lucrative award in mathematics. He contributed most of the \$50,000 he received to a scholarship in Israel in

the name of his parents. "I kept only seven hundred and twenty dollars," Erdős says, "and I remember someone commenting that for me even that was a lot of money to keep." The two times he lectured in India he had the fee sent to a woman he has never met, the widow of Srinivasa Ramanujan, a legendary mathematical prodigy who died of tuberculosis at the age of thirty-two. Whenever Erdős learns of a good cause—a struggling classical-music radio station, a fledgling Native American movement—he promptly makes a small donation.

ERDÖS WAS BORN IN BUDAPEST ON MARCH 26, 1913, the son of two high school mathematics teachers. While his mother, Anna, was in the hospital giving birth to him, her two daughters, ages three and five, contracted septic scarlet fever and died within the day. "It was something my mother didn't like to talk about," Erdős says. "Their names were Clara and Magda, I think." Of the three children, the girls were considered to be the smart ones.

When Erdős was one and a half, his father, Lajos, was captured in a Russian offensive and sent to Siberia for six years. Erdős's mother kept him out of school, fearing that it was the source of childhood contagions. He stayed home until high school, and even then he went only every other year, because his mother kept changing her mind.

Erdős was a mathematical prodigy. At three he could multiply three-digit numbers in his head. At four he discovered negative numbers. "I told my mother," he recalls, "that if you take two hundred and fifty from a hundred you get minus a hundred and fifty." He knew then that he wanted to be a mathematician, although he would pay attention to his tutorials in history, politics, and biology. As soon as he could read, his mother plied him with medical literature, which he eagerly studied. She apparently had vague hopes that he might become a doctor.

When Erdős was seventeen, he entered the University of Budapest; he was graduated four years later with a Ph.D. in mathematics. In October of 1934 he went to Manchester, England, for a four-year postdoctoral fellowship. "I left Hungary for political reasons," Erdős says. "I was Jewish, and Hungary was a semi-fascist country. But I was very homesick, so I went back three times a year, for Easter, Christmas, and the summer. In March, 1938, Hitler went into Austria, and it was too dangerous for me to return to Hungary in the spring. I did slip back in during the summer. But on September 3, 1938, I didn't like the news—the Czech crisis—so I went back to England that evening and was on my way to the United States three and a half weeks later. The Nazis ended up murdering four of my mother's five brothers and sisters, and my father died of a heart attack in 1942.

"Then my problems started with Sam and Joe. I didn't want to return to Hungary because of Joe. In 1954 I was invited to an international mathematics conference in Amsterdam. Sam didn't want to give me a re-entry permit. It

was the McCarthy era. The immigration officials asked me all sorts of silly questions. 'Have you read Marx, Engels, or Stalin?' 'No,' I said. 'What do you think of Marx?' they pressed. 'I'm not competent to judge,' I said, 'but no doubt he was a great man.' So they denied me a re-entry visa. I had the classic American reaction: I left. I ended up mostly in Israel. In the 1960s Sam decided it was okay for me to return."

In 1964 his mother, at the age of eighty-four, started traveling with him. For the next seven years she accompanied him everywhere except to India, which she avoided because of her fear of disease. His mother hated traveling—she knew barely a word of English, and he traveled regularly to English-speaking countries—but she wanted to be with him. Wherever he did mathematics, she sat quietly, basking in his genius. They ate every meal together, and at night he held her hand until she fell asleep. "She saw in Paul the world," Fredro says. "He was her God, her everything. They stayed with me in 1968 or 1969. When they were together, I was nobody. It was like I didn't exist. That hurt me a lot, because I was very close to her. She was my aunt, and when I got out of Auschwitz, I went first to her home. She fed me and bathed me and clothed me and made me a human being again."

In 1971 Erdős's mother died of a bleeding ulcer in Calgary, Canada, where Erdős was giving a lecture. Apparently, she had been misdiagnosed, and her life might otherwise have been saved. Soon afterward Erdős started taking a lot of pills, first anti-depressants and then amphetamines. As one of Hungary's leading scientists, he had no trouble getting sympathetic Hungarian doctors to prescribe drugs. "I was very depressed," Erdős says, "and Paul Turán, an old friend, reminded me, 'A strong fortress is our mathematics.'" Erdős took the advice to heart and started putting in nineteen-hour days, churning out papers that would change the course of mathematical history. Still, math proved more of a sieve than a fortress. Ten years later, one day when Erdős was looking particularly gloomy, a friend asked him what was wrong. "Haven't you heard?" he replied. "My mother has left." Even today he never sleeps in the apartment that they once shared in Budapest, using it only to house visitors; he stays in a guest suite at the Hungarian Academy of Sciences.

Long before his mother died, Erdős became preoccupied with his own mortality. "My second great discovery [the first being negative numbers]," he says, "was death. Children don't think they're ever going to die. I was like that too, until I was four. I was in a shop with my mother and suddenly I realized I was wrong. I started to cry. I knew I would die. From then on I've always wanted to be younger. In 1970 I preached in Los Angeles on 'my first two-and-a-half billion years in mathematics.' When I was a child, the earth was said to be two billion years old. Now scientists say it's four and a half billion. So that makes me two-and-a-half billion. The students at the lecture drew a time line that showed me riding a dinosaur. I was asked, 'How were the dinosaurs?' Later, the right answer oc-

curred to me: You know, I don't remember, because an old man only remembers the very early years, and the dinosaurs were born yesterday, only a hundred million years ago."

In the early 1970s Erdős started appending the initials P.G.O.M. to his name, which stand for Poor Great Old Man. When he turned sixty, he became P.G.O.M.L.D., the L.D. for Living Dead. At sixty-five he graduated to P.G.O.M.L.D.A.D., the A.D. for Archaeological Discovery. At seventy he became P.G.O.M.L.D.A.D.L.D., the L.D. for Legally Dead. And he plans next year, at seventy-five, to be P.G.O.M.L.D.A.D.L.D.C.D., the C.D. for Counts Dead. He explains, "The Hungarian Academy of Sciences has two hundred members. When you turn seventy-five, you can stay in the academy with full privileges, but you no longer count as a member. That's why the C.D. Of course, maybe I won't have to face that emergency. They are planning an international conference for my seventy-fifth birthday. It may have to be for my memory. I'm miserably old. I'm really not well. I don't understand what's happening to my body—maybe the final solution."

When Paul Turán, the man who had counseled, "A strong fortress is our mathematics," died, in 1976, Erdős had an image of the SF assessing the work he had done with his collaborators. On one side of a balance the SF would place the papers Erdős had co-authored with the dead, on the other side the papers written with the living. "When the dead side tips the balance," Erdős says, "I must die too." He pauses for a moment and then adds, "It's just a joke of mine."

Perhaps. But Erdős vigorously seeks out new, young collaborators and ends many working sessions with the remark, "We'll continue tomorrow, if I live." With more than 250 co-authors, Erdős has collaborated with more people than any other mathematician in history. Those lucky 250 are said to have "an Erdős number of 1," a coveted code phrase in the mathematics world for having written a paper with the master himself. If your Erdős number is 2, it means you have worked with someone who has worked with Erdős. If your Erdős number is 3, you have worked with someone who has worked with someone who has worked with Erdős. The mathematical literature is peppered with tongue-in-cheek papers probing the properties of Erdős numbers. Einstein had an Erdős number of 2, and the highest known Erdős number is 7.

Since 1954 Erdős has been spurring on his collaborators by putting out contracts on problems he hasn't been able to solve. The outstanding rewards total about \$10,000, and range from \$10 to \$3,000, reflecting his judgment of the problems' difficulty. "I've had to pay out three or four thousand dollars," Erdős says. "Someone once asked me what would happen if all the problems were solved at once. Could I pay? Of course I couldn't. But what would happen to the strongest bank if all the creditors asked for their money back? The bank would surely go broke. A run on the bank is much more likely than solutions to all my problems."

THOUGH HE IS CONFIDENT OF HIS SKILL WITH MATHEMATICS, outside that arcane world Erdős is very nearly helpless. Since his mother's death the responsibility of looking after him has fallen chiefly to Ronald Graham, who spends almost as much time handling Erdős's affairs as he does overseeing the seventy mathematicians, statisticians, and computer scientists at Bell Labs. Graham is the one who calls Washington when the SF steals Erdős's visa, and, he says, "the SF is striking with increasing frequency these days." Graham also manages Erdős's money, and was forced to become an expert on currency exchange rates because honoraria from Erdős's lectures dribble in from four continents. "I sign his name on checks and deposit them," Graham says. "I've been doing this so long I doubt the bank would cash a check if he endorsed it himself."

On the wall of Graham's office, in Murray Hill, New Jersey, is a sign: ANYONE WHO CANNOT COPE WITH MATHEMATICS IS NOT FULLY HUMAN. AT BEST HE IS A TOLERABLE SUBHUMAN WHO HAS LEARNED TO WEAR SHOES, BATHE, AND NOT MAKE MESSSES IN THE HOUSE. Near the sign is the "Erdős room," a closet full of filing cabinets containing copies of Erdős's 1,000-plus articles. "Since he has no home," Graham says, "he depends on me to keep his papers. He's always asking me to send some of them to one person or another." Graham also handles all of Erdős's incoming correspondence, which is no small task, because many of Erdős's mathematical collaborations take place by mail. Last year Erdős sent out 1,500 letters, none of which dwelt on subjects other than mathematics. "I am in Australia," a typical letter begins. "Tomorrow I leave for Hungary. Let k be the largest integer. . . ."

Graham has had less success influencing Erdős's health. "He badly needs a cataract operation," Graham says. "I've been trying to persuade him to schedule it. But he refuses, because he'd be laid up for a week and he doesn't want to miss even seven days of working with mathematicians. He's afraid of being old and helpless and senile." Like all of Erdős's friends, Graham is concerned about his drug-taking. In 1979 Graham bet him \$500 that he couldn't stop taking amphetamines for a month. Erdős accepted the challenge, and went cold turkey for thirty days. After Graham paid up—and wrote the \$500 off as a business expense—Erdős said, "You've showed me I'm not an addict. But I didn't get any work done. I'd get up in the morning and stare at a blank piece of paper. I'd have no ideas, just like an ordinary person. You've set mathematics back a month." He promptly resumed taking pills, and mathematics has been the better for it.

Graham recently built an addition onto his house, in Watchung, New Jersey, so that Erdős would have his own bedroom and library for the thirty or so days he's there each year. Erdős likes staying with Graham because the household contains a second strong mathematician, Graham's wife, Fan Chung, a Taiwanese émigré who is the director of mathematics at Bell Communications Research, a spinoff of Bell Labs that does research for the regional

phone companies. When Graham won't play with him, Chung will, and the two have co-authored fifteen papers.

Graham and Erdős seem an unlikely pair. Although Graham is one of the world's leading mathematicians, he has not, like Erdős, forsaken body for mind. Indeed, he has pushed both to the limit. At six foot two, with blond hair, blue eyes, and chiseled features, Graham looks at least a decade younger than his fifty-two years. He is an accomplished trampolinist, and he put himself through college as a circus acrobat. He can juggle six balls and is a past president of the International Jugglers Association. He has bowled two 300 games, is vicious with a boomerang, and more than holds his own at tennis and Ping-Pong.

While Erdős can sit for hours, Graham is always moving. In the middle of solving a mathematical problem he'll spring into a handstand, grab stray objects and juggle them, or jump up and down on the super-springy pogo stick he keeps in his office. "You can do mathematics anywhere," Graham says. "I once had a flash of insight into a stubborn problem in the middle of a back somersault with a triple twist on my trampoline."

"If you add up Ron's mathematical theorems and his double somersaults," one of his colleagues says, "he'd surely have a record." Graham, in fact, does hold a world record—one no less peculiar. He is cited in the *Guinness Book of World Records* for having used the largest number in a mathematical proof. The number is incomprehensibly large. Mathematicians often try to suggest the magnitude of a large number by likening it to the number of atoms in the universe or the number of grains of sand in the Sahara. Graham's number has no such physical analogue. It can't even be expressed in familiar mathematical notation, as, say, the number 1 followed by a zillion zeros. To cite it a special notation had to be invoked, in which exponents are heaped on exponents to form a staggering leaning tower of digits.

Besides staying on the cutting edge of mathematics and acrobatics, Graham has found time to learn Chinese and take up the piano. Neither his wife nor his co-workers understand how he does it. "It's easy," Graham says. "There are a hundred and sixty-eight hours in every week."

Erdős and Graham met in 1963 in Boulder, Colorado, at a conference on number theory, and they have been collaborating ever since, writing twenty-five papers and one book together. That meeting was also the first of many spirited athletic encounters the two have had. "I remember thinking when we met that he was kind of an old guy," Graham says, "and I was amazed that he beat me at Ping-Pong. That defeat got me to take up the game seriously." Graham bought a machine that served Ping-Pong balls at very high speeds and went on to become Ping-Pong champion of Bell Labs. "We still play occasionally," Graham says. "Paul loves challenges. I give him nineteen points and play sitting down. But his eyesight is so bad that I can just lob the ball high into the air and he'll lose track of it."

In recent years Erdős has come up with novel athletic contests at which he'd seem to have more of a chance,

though he invariably loses. "Paul likes to imagine situations," Graham says. "For example, he wondered whether I could climb stairs twice as fast as he could. We decided to see. I ran a stopwatch as we both raced up twenty flights in an Atlanta hotel. When he got to the top, huffing, I punched the stopwatch but accidentally erased the times. I told him we'd have to do it again. 'We're *not* doing it again,' he grumbled, and stalked off.

"Another time, in Newark Airport, Erdős asked me how hard it was to go up a down escalator. I told him it could be done, and I demonstrated. 'That was harder than I thought,' I said. 'That looks easy,' he said. 'I'm sure you couldn't do it,' I said. 'That's ridiculous,' he said. 'Of course I can.' Erdős took about four steps up the escalator and then fell over on his stomach and slid down. People were staring at him. He was wearing this ratty coat and looked like he was a wino from the Bowery. He was indignant afterward."

Erdős and Graham are like an old married couple, happy as clams but bickering incessantly, following scripts they know by heart though they are baffling to outsiders. Many of these scripts center on food. When Erdős is feeling well, he gets up about 5:00 A.M. and starts banging around. He'd like Graham to make him breakfast, but Graham thinks he should make his own. Erdős loves grapefruit, and Graham stocks the refrigerator when he knows Erdős is coming. On a recent visit Erdős, as always, peeked into the refrigerator and saw the fruit. In fact, each knew that the other knew that the fruit was there.

"Do you have any grapefruit?" Erdős asked.

"I don't know," Graham replied. "Did you look?"

"I don't know where to look."

"How about the refrigerator?"

"Where in the refrigerator?"

"Well, just look."

Erdős found a grapefruit. He looked at it and looked at it and got a butter knife. "It can't be by chance," Graham explains, "that he so often uses the dull side of the knife, trying to force his way through. It'll be squirting like mad, all over himself and the kitchen. I'll say, 'Paul, don't you think you should use a sharper knife?' He'll say, 'It doesn't matter,' as the juice shoots across the room. At that point I give up and cut it for him."

In mathematics Erdős's style is one of intense curiosity, a style he brings to everything else he confronts. Part of his mathematical success stems from his willingness to ask fundamental questions, to ponder critically things that others have taken for granted. He also asks basic questions outside mathematics, but he never remembers the answers, and asks the same questions again and again. He'll point to a bowl of rice and ask what it is and how it's cooked. Graham will pretend he doesn't know; others at the table will patiently tell Erdős about rice. But a meal or two later Erdős will be served rice again, act as if he's never seen it, and ask the same questions.

Erdős's curiosity about food, like his approach to so many things, is merely theoretical. He'd never actually try

to cook rice. In fact, he's never cooked anything at all, or even boiled water for tea. "I can make excellent cold cereal," he says, "and I could probably boil an egg, but I've never tried." Erdős was twenty-one when he buttered his first piece of bread, his mother or a domestic servant having always done it for him. "I remember clearly," he says. "I had just gone to England to study. It was tea time, and bread was served. I was too embarrassed to admit that I had never buttered it. I tried. It wasn't so hard." Only ten years before, at the age of eleven, he had tied his shoes for the first time.

His curiosity about driving is legendary in the mathematics community, although you'll never find him behind the wheel. He doesn't have a license and depends on a network of friends, known as Uncle Paul sitters, to chauffeur him around. But he's constantly asking what street he's on and questioning whether it's the right one. "He's not a nervous wreck," Graham says. "He just wants to know. Once he was driving with Paul Turán's widow, Vera Sós. She had just learned to drive, and Paul was doing his usual thing. 'What about this road?' 'What about that road?' 'Shouldn't we be over there?' Vera was distracted and she plowed into the side of a car that must have been going forty or fifty miles an hour. She totaled it, and vowed that she would never drive with Erdős again."

But outside mathematics Erdős's inquisitiveness is limited to necessities like eating and driving; he has no time for frivolities like sex, art, novels, or movies. Once in a while the mathematicians he stays with force him to join their families on non-mathematical outings, but he accompanies them only in body. "I took him to the Johnson Space Center to see rockets," one of his colleagues recalls, "but he didn't even look up." Another mathematician took him to see a mime troupe, but he fell asleep before the performance started. A colleague whose wife is a curator at the Museum of Modern Art dragged Erdős to MOMA. "We showed him Matisse, but he would have nothing to do with it. After a few minutes we ended up sitting in the sculpture garden doing mathematics." Erdős hasn't read a novel since the 1940s, and thirty years have passed since he last saw a movie, *Cold Days*, the story of a 1942 atrocity in Novasad, Yugoslavia, in which Hungarians brutally drowned a few thousand Jews and Russians.

Erdős is a mathematical monk. He has renounced physical pleasure and material possessions for an ascetic, contemplative life, a life devoted to a single narrow mission: uncovering mathematical truth. What is this mathematics that could possibly be so diverting and consuming?

"THERE'S AN OLD DEBATE," ERDÖS SAYS, "ABOUT whether you create mathematics or just discover it. In other words, are the truths already there, even if we don't yet know them? If you believe in God, the answer is obvious. Mathematical truths are there in the SF's mind, and you just rediscover them. Remember the limericks:

There was a young man who said, 'God,
It has always struck me as odd
That the sycamore tree
Simply ceases to be
When there's no one about in the quad.'

'Dear Sir, Your astonishment's odd;
I am always about in the quad:
And that's why the tree
Will continue to be,
Since observed by,
Yours faithfully, God.'

"I'm not qualified to say whether or not God exists. I kind of doubt He does. Nevertheless, I'm always saying that the SF has this transfinite Book—transfinite being a concept in mathematics that is larger than infinite—that contains the best proofs of all mathematical theorems, proofs that are elegant and perfect." The strongest compliment Erdős can give to a colleague's work is to say, "It's straight from the Book."

"I was once introducing Erdős at a lecture," says Joel Spencer, a mathematician at SUNY at Stony Brook who has worked with Erdős since 1970. "And I started to talk about his idea of God and the Book. He interrupted me and said, 'You don't have to believe in God, but you should believe in the Book.' Erdős has made me and other mathematicians recognize the importance of what we do. Mathematics is there. It's beautiful. It's this jewel we uncover."

That mathematics could be a jewel may come as a surprise to those of us who struggled with multiplication tables as kids and now need help completing W-4 forms. Mathematics is a misunderstood and even maligned discipline. It's not the brute computations they drilled into us in grade school. It's not the science of reckoning. Mathematicians do not spend their time thinking up cleverer ways of multiplying, faster methods of adding, better schemes for extracting cube roots. Even those drawn to the subject have had misconceptions. "I always wanted to be a mathematician," Spencer says, "even before I knew what mathematicians did. My father was a CPA, and I loved numbers. I thought mathematics was about adding up longer and longer lists. I found out what it really was in high school. I'd undoubtedly be a lot richer now if I were making my living adding up long lists of numbers."

Erdős's cousin Magda Fredro hasn't the slightest idea what he does, even though she has known him for sixty years and has accompanied him on mathematical sojourns from Florida to Israel. "Tell me, what is this about?" she asked me, flipping through her copy of Erdős's book *The Art of Counting*. "It looks like Chinese. Also, tell me, how famous and brilliant is he? I know so little about him. He once looked up six phone numbers. Then we talked for half an hour before he phoned them all, from memory. More than all his scientific work, that impressed me."

For Erdős, Graham, and their colleagues, mathematics is order and beauty at its purest, order that transcends the physical world. When Euclid, the Greek geometer of the

third century B.C., spoke of points and lines, he was speaking of idealized entities, points that have no dimension and lines that have no width. All points and lines that exist in the real world—in, say, physics or engineering—do have dimension and thus are only imperfect imitations of the pure constructs that geometers ponder. Only in this idealized world do the angles of every triangle always sum to precisely 180 degrees.

Numbers, too, can have this transcendent quality. Take the prime numbers, integers like 2, 3, 5, 7, 11, 13, and 17, which are evenly divisible only by themselves and the number 1. We happen to have ten fingers, and our number system is conveniently based on ten digits. But the same primes, with all the same properties, exist in any number system. If we had twenty-six fingers and constructed our number system accordingly, there would still be primes. The universality of primes is the key to Carl Sagan's novel *Contact*, in which extraterrestrials, with God only knows how many fingers, signal earthlings by emitting radio signals at prime-number frequencies. But little green men need not be invoked in order to conceive of a culture that doesn't use base 10. We have had plenty here on Earth. Computers use a binary system, and the Babylonians had a base-60 system, vestiges of which are evident in the way we measure time (sixty seconds in a minute, sixty minutes in an hour). Cumbersome as this sexagesimal system was, it too contained the primes.

Prime numbers are like atoms. They are the building blocks of all integers. Every integer is either itself a prime or the unique product of primes. For example, 11 is a prime; 12 is the product of the primes 2, 2, and 3; 13 is a prime; 14 is the product of the primes 2 and 7; 15 is the product of the primes 3 and 5, and so on. Some 2,300 years ago, in proposition 20 of Book IX of his *Elements*, Euclid gave a proof, "straight from the Book," that the supply of primes is inexhaustible. As of this writing, the largest known prime is a 65,050-digit number formed by raising 2 to the 216,091st power and subtracting 1. But Euclid's work shows that there are infinitely many others. Only in mathematics, of all the sciences, do the ancients occasionally have the final word.

Prime numbers have always had an almost mystical appeal. "I even know of a mathematician who slept with his wife only on prime-numbered days," Graham says. "It was pretty good early in the month—two, three, five, seven—but got tough toward the end, when the primes are thinner, nineteen, twenty-three, then a big gap till twenty-nine." Prime numbers are appealing because, in spite of their apparent simplicity, their properties are extremely elusive. All sorts of basic questions about them remain unanswered, even though they have been scrutinized by generations of the sharpest mathematical minds. In 1742, for example, Christian Goldbach conjectured that every even number greater than 2 is the sum of two primes: $4 = 2 + 2$, $6 = 3 + 3$, $8 = 5 + 3$, $10 = 5 + 5$, $12 = 7 + 5$, $14 = 7 + 7$, and so on. With the aid of computers, twentieth-century mathematicians have decomposed all even num-

bers up to 100 million into the sum of two primes, but they have not been able to prove that Goldbach's simple conjecture is universally true. Similarly, computer searches have revealed numerous "twin primes," pairs of consecutive odd numbers both of which are prime: 3 and 5; 5 and 7; 11 and 13; 71 and 73; 1,000,000,000,061 and 1,000,000,000,063. Number theorists believe that the supply of twin primes is inexhaustible, like the supply of primes themselves, but no one has been able to prove this. On an even deeper level, no one has found an easy way of telling in advance how far one prime number will be from the next one.

The prime numbers are Erdős's intimate friends. He

In 1939 Erdős attended a lecture at Princeton by Marc Kac, a Polish émigré mathematical physicist who would contribute to the American development of radar during the Second World War. "He half-dozed through most of my lecture," Kac wrote in his autobiography. "The subject matter was too far removed from his interests. Toward the end I described briefly my difficulties with the number of prime divisors. At the mention of number theory Erdős perked up and asked me to explain once again what the difficulty was. Within the next few minutes, even before the lecture was over, he interrupted to announce that he had the solution!"

In 1949 Erdős had his greatest victory over the prime



understands them better than anyone else does. "When I was ten," he says, "my father told me about Euclid's proof, and I was hooked." Seven years later, as a college freshman, he caused a stir in Hungarian mathematics circles with a simple proof that a prime can always be found between any integer (greater than 1) and its double. This result had already been proved in about 1850 by one of the fathers of Russian mathematics, Pafnuty Lvovitch Chebyshev. But Chebyshev's proof was too heavy-handed to be in the Book. He had used a steam shovel to transplant a rosebush, whereas Erdős managed with a silver spoon. News of Erdős' youthful triumph was spread by the ditty "Chebyshev said it, and I say it again/ There is always a prime between n and $2n$."

numbers, although the victory is one he doesn't like to talk about, because it was marred by controversy. Although mathematicians have no effective way of telling exactly where prime numbers lie, they have known since 1896 a formula that describes the statistical distribution of primes, how on average the primes thin out the further out you go. Like Chebyshev's proof, the 1896 proof of what's called the Prime Number Theorem depended on heavy machinery, and the brightest mathematical minds were convinced that the theorem couldn't be proved with anything less. Erdős and Atle Selberg, a colleague who was not yet well known, stunned the mathematics world with an "elementary" proof. According to Erdős's friends, the two agreed that they'd publish back-to-back papers in a

leading journal delineating their respective contributions to the proof. Erdős then sent out postcards to mathematicians informing them that he and Selberg had conquered the Prime Number Theorem. Selberg apparently ran into a mathematician he didn't know who had received a postcard, and the mathematician immediately said, "Have you heard? Erdős and What's His Name have an elementary proof of the Prime Number Theorem." Reportedly, Selberg was so injured that he raced ahead and published without Erdős, and thus got the lion's share of credit for the proof. In 1950 Selberg alone was awarded the Fields medal, the closest equivalent in mathematics to a Nobel Prize, in large part for his work on the Prime Number Theorem.

Priority fights are not uncommon in mathematics. Unlike other scientists, mathematicians leave no trail of laboratory results to substantiate who did what. Indeed, Erdős has been spending much time these days mediating a priority fight among three of his closest collaborators. "When I was a graduate student," Joel Spencer says, "I thought only third-rate mathematicians would have these fights. But it's actually first-rate mathematicians. They're the ones who are passionate about mathematics." If they can't fathom what's in the SF's Book, they don't want anyone else to. The late R. L. Moore, a strong Texas mathematician, put it bluntly: "I'd rather a theorem not be thought of than I not be the one who thinks of it."

In February, Erdős and 320 of his colleagues gathered at Florida Atlantic University, in Boca Raton, for the largest conference ever in combinatorics, a burgeoning branch of mathematics that encompasses problems involving objects that must be counted and classified. (Combinatorics was officially launched in 1736 in the East Prussian city of Königsberg, now the Soviet town of Kaliningrad, when Leonhard Euler, a twenty-nine-year-old mathematical phenom, proved that one couldn't take a round-trip stroll across all of the city's seven bridges without crossing at least one bridge more than once, and then generalized his argument to apply to any odd number of bridges.) At Boca Raton one of the combinatorialists gave a formal talk in which he presented a result but refused to share the proof. The proof apparently introduced a powerful technique that he wanted to keep secret until he had squeezed it dry of whatever other results it might yield.

ERDÖS DOESN'T LIKE TO THINK ABOUT SUCH COMPETITIVENESS. For him mathematics is a glorious combination of science and art. On the one hand, it is the science of certainty, because its conclusions are logically unassailable. Unlike biologists, chemists, or even physicists, Erdős, Graham, and their fellow mathematicians *prove* things. Their conclusions follow syllogistically from premises, in the same way that the conclusion "Ronald Reagan is mortal" follows from the premises "All Presidents are mortal" and "Ronald Reagan is a President." On the other hand, mathematics has an aesthetic side. A conjecture can be "obvious" or "unexpected." A result can be

"trivial" or "beautiful." A proof can be "messy," "surprising," or, as Erdős would say, "straight from the Book."

What is more, a proof should ideally provide insight into why a particular result is true. Consider one of the most famous results in modern mathematics, the four-color-map theorem, which states that no more than four colors are needed to paint any conceivable flat map of real or imaginary countries in such a way that no two bordering countries have the same color. From the middle of the nineteenth century most mathematicians believed that this seductively simple theorem was true, but for 124 years a parade of distinguished mathematicians and dedicated amateurs searched in vain for a proof (or, conceivably, a counterexample). In 1976 Kenneth Appel and Wolfgang Haken, of the University of Illinois, finally conquered this mathematical Mount Everest. I was an undergraduate at Harvard at the time, and when word of the proof reached Cambridge, my instructor in calculus cut short his lecture and served champagne. Some days later we learned to our dismay that Appel and Haken's proof had made unprecedented use of high-speed computers: more than 1,000 hours logged among three machines. What Appel and Haken had done was to demonstrate that all possible maps are variations of more than 1,500 fundamental cases, each of which the computer was then able to paint using at most four colors. The proof was simply too long to be checked by hand, and some mathematicians feared that the computer might have slipped up and made a subtle error. Today, more than a decade later, the validity of the proof is generally acknowledged, but many still regard the proof as unsatisfactory. "I'm not an expert on the four-color problem," Erdős says, "but I assume the proof is true. However, it's not beautiful. I'd prefer to see a proof that gives insight into why four colors are sufficient."

Beauty and insight—these are words that Erdős and his colleagues use freely but have difficulty explaining. "It's like asking why Beethoven's Ninth Symphony is beautiful," Erdős says. "If you don't see why, someone can't tell you. I *know* numbers are beautiful. If they aren't beautiful, nothing is."

Pythagoras of Samos evidently felt the same way. In the sixth century B.C. he made a kind of religion out of numbers, believing that they were not merely instruments of enumeration but sacred, perfect, friendly, lucky, or evil. Pythagoras saw perfection in any integer that equaled the sum of all the other integers that divided evenly into it. The first perfect number is 6. It's evenly divisible by 1, 2, and 3, and it's also the sum of 1, 2, and 3. The second perfect number is 28. Its divisors are 1, 2, 4, 7, and 14, and they add up to 28. During the Middle Ages religious scholars asserted that the perfection of 6 and 28 was part of the fabric of the universe: God created the world in six days and the moon orbits the earth every 28 days. Saint Augustine believed that the properties of the numbers themselves, not any connection to the empirical world, made them perfect: "Six is a number perfect in itself, and not because God created all things in six days; rather the in-

verse is true; God created all things in six days because this number is perfect. And it would remain perfect even if the work of the six days did not exist."

The ancient Greeks knew of only two perfect numbers besides 6 and 28: 496 and 8,128. Since the four perfect numbers they knew were all even, they wondered whether an odd perfect number existed. Today Erdős and his colleagues know thirty perfect numbers, the largest having 130,100 digits, and all thirty are even. But they cannot rule out the possibility that the thirty-first perfect number will be odd. Whether an odd perfect number exists is among the oldest unsolved problems in mathematics. Equally daunting is the unsolved problem of how many perfect numbers there are.

Pythagoras considered the numbers 220 and 284 to be "friendly." His concept of a friendly number was based on the idea that a human friend is a kind of alter ego. Pythagoras wrote, "[A friend] is the other I, such as are 220 and 284." These numbers have a special mathematical property: each is equal to the sum of the other's divisors. That is, the divisors of 220 are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55, and 110, and they sum to 284; the divisors of 284 are 1, 2, 4, 71, and 142, and they sum to 220. Like perfect numbers, friendly numbers appear in the Bible. In Genesis 32:14, Jacob gives Esau 220 goats ("two hundred she-goats and twenty he-goats") as a gesture of friendship.

A second pair of friendly numbers (17,296 and 18,416) was not discovered until 1636, by Pierre de Fermat. By the middle of the nineteenth century many able mathematicians had searched for pairs of friendly numbers, and some sixty had been found. But not until 1866 was the second *smallest* pair, 1,184 and 1,210, discovered, by a sixteen-year-old Italian. By now hundreds of friendly numbers have been discovered, but, as with perfect numbers and twin primes, even today no one knows whether their supply is inexhaustible. Erdős thinks it is, and he wrote one of the earliest papers in the literature on the distribution of friendly numbers. Why it should be so much easier to prove that the number of primes is infinite is one of the great unanswered meta-questions of mathematics.

Perfect numbers and friendly numbers are among the areas of mathematics in which child prodigies tend to show their stuff. Like chess and music, such areas do not require much technical expertise. No child prodigies exist among historians or legal scholars, because years are needed to master those disciplines. A child can learn the rules of chess in a few minutes, and native ability takes over from there. So it is with areas of mathematics like these, which are aspects of elementary number theory, or the study of the integers, and combinatorics. You can easily explain prime numbers, perfect numbers, and friendly numbers to a child, and he can start playing around with them and exploring their properties. Many areas of mathematics, however, require technical expertise, which is acquired over years of assimilating definitions and previous results. By the time mathematical prodigies mature and enter college, they usually have the patience to master these more tech-

nical areas—and often go on to make great discoveries in them. Erdős is an exception. He has stuck chiefly to areas of mathematics in which prodigies excel.

This is not to say that his mathematical interests are narrow. On the contrary, he has opened up whole new areas of mathematics. But, like number theory, these areas typically require a minimum of technical knowledge. These are areas that the next generation of prodigies will find captivating.

Erdős's forte is coming up with short, clever solutions. He solves problems not by grinding out pages of equations but by constructing succinct, insightful arguments. He is a mathematical wit, and his shrewdness often extends to problems outside his areas of specialty. "In 1976 we were having coffee in the mathematics lounge at Texas A & M," recalls George Purdy, a geometer who has worked with Erdős since 1967. "There was a problem on the blackboard in functional analysis, a field Erdős knew nothing about. I happened to know that two analysts had just come up with a thirty-page solution to the problem and were very proud of it. Erdős looked up at the board and said, 'What's that? Is it a problem?' I said yes, and he went up to the board and squinted at the tersely written statement. He asked a few questions about what the symbols represented, and then he effortlessly wrote down a two-line solution. If that's not magic, what is?"

Erdős is the consummate problem solver. Most elderly mathematicians, if they're still going strong, are theory builders. They have stopped solving problems and are setting a general agenda for mathematical research, pointing to new or neglected areas that younger talent should pursue. Not Erdős. As long as problems remain to be solved, he'll be slugging it out in the trenches.

ONE OF THE AREAS IN WHICH ERDÖS HAS PIONEERED is a philosophically appealing aspect of combinatorics called Ramsey theory. It is the area in which Graham's record-setting number comes into play. The idea underlying Ramsey theory is that complete disorder is an impossibility. The appearance of disorder is really a matter of scale. Any mathematical "object" can be found if sought in a large enough universe. "In the TV series *Cosmos*, Carl Sagan appealed to Ramsey theory without knowing that's what he was doing," Graham says. "Sagan said people often look up and see, say, eight stars that are almost in a straight line. Since the stars are lined up, the temptation is to think that they were artificially put there, as beacons for an interstellar trade route, perhaps. Well, Sagan said, if you look at a large enough group of stars, you can see almost anything you want. That's Ramsey theory in action."

In Sagan's example the mathematician would want to know the smallest group of arbitrarily positioned stars that will always contain eight that are lined up. In general, the Ramsey theorist seeks the smallest "universe" that's guaranteed to contain a certain object. Suppose the object is

not eight stars in a row but two people of the same sex. In this case the Ramsey theorist wants to know the smallest number of people that will always include two people of the same sex. Obviously, the answer is three.

Ramsey theory takes its name from Frank Plumpton Ramsey, a brilliant student of Bertrand Russell, G. E. Moore, Ludwig Wittgenstein, and John Maynard Keynes, who might well have surpassed his teachers had he not died of jaundice in 1930, at the age of twenty-six. While his brother Michael pursued the transcendent reality that theology offers (he became the Archbishop of Canterbury), Frank Ramsey, a spirited atheist, pursued the transcendent reality that mathematics offers. He also studied philosophy and economics, writing two papers on taxation and savings that were heralded by Keynes and are still widely cited in the economics literature. But it is eight pages of mathematics that have made him eponymous—eight pages that Erdős seized on and developed into a full-fledged branch of mathematics. Like all the problems Erdős works on, Ramsey problems can be simply stated, although the solutions are often hard to come by.

The classic Ramsey problem involves guests at a party. What is the minimum number of guests that need to be invited so that either at least three guests will know each other or at least three won't? Mathematicians, as is their trademark, are careful to articulate their assumptions. Here they assume that the relation of knowing someone is symmetric: if Sally knows Billy, Billy knows Sally.

With this assumption in mind, consider a party of six. Call one of the guests David. Now, since David knows or doesn't know each of the other five, he will either know at least three of them or not know at least three. Assume the former (the argument works the same way if we assume the latter). Now consider what relationships David's three acquaintances might have among themselves. If any two of the three are acquaintances, they and David will constitute three who know each other—and we have our quorum. That leaves only the possibility that David's three acquaintances are all strangers to one another—but that achieves the quorum too, for they constitute three guests who do not know each other. To understand why a party of five is not enough to guarantee either three people all of whom know each other or three people none of whom do, ponder the case of Michael, who knows two and only two people, each of whom knows a different one of the two people Michael doesn't know.

Q.E.D., or *quod erat demonstrandum*, as Erdős would say. We have just written out a mathematical proof—perhaps not one from the Book, but a proof nonetheless. And the proof provides *insight* into why a party of six must include at least three mutual acquaintances or three mutual strangers. Another way to prove this is by brute force, listing all conceivable combinations of acquaintanceship among six people—32,768 such possibilities exist—and checking to see that each combination includes the desired relationship. This brute-force proof, however, would not provide insight.

Suppose we want not a threesome but a foursome who either all know each other or are strangers. How large must the party be? Erdős and Graham and their fellow Ramsey theorists can prove that eighteen guests are necessary. But raise the ante again, to a fivesome, and no one knows how many guests are required. The answer is known to lie between forty-two and fifty-five. That much has been known for two decades, and Graham suspects that the precise number won't be found for at least a hundred years. The case of a sixsome is even more daunting, with the answer known to lie between 102 and 169. The ranges grow wider still for higher numbers.

Erdős likes to tell the story of an evil spirit that can ask you anything it wants. If you answer incorrectly, it will destroy humanity. "Suppose," Erdős says, "it decides to ask you the Ramsey party problem for the case of a fivesome. Your best tactic, I think, is to get all the computers in the world to drop what they're doing and work on the problem, the brute-force approach of trying all-the specific cases"—of which there are more than 10 to the 200th power (the number 1 followed by 200 zeros). "But if the spirit asks about a sixsome, your best survival strategy would be to attack the spirit before it attacks you. There are too many cases even for computers."

Graham's record-setting number comes up in a similar problem. Take any number of people and list every possible committee that could be formed from them, including committees of one and a committee of the whole. The "object" Graham wants to find is four committees that can be split into two groups of two committees each in such a way that each person belongs to the same number of committees in each group. How many people are required to guarantee the presence of four such committees? Graham suspects that the answer is six, but all that he or anyone else has been able to prove is that four such committees will always exist if the number of people is equal to his record-setting number. This astonishing gap between what is suspected, based on observations of specific cases, and what is known shows how hard Ramsey theory is.

Graham, whose license plate reads RAMSEY, thinks that centuries may pass before much of Erdős's and his work in Ramsey theory has applications in physics, engineering, or elsewhere in the real world, including his place of employment, AT&T. "The applications aren't the point," Graham says. "I look at mathematics pretty globally. It represents the ultimate structure and order. And I associate doing mathematics with control. Jugglers like to be able to control a situation. There's a well-known saying in juggling: 'The trouble is that the balls go where you throw them.' It's just you. It's not the phases of the moon, or someone else's fault. It's like chess. It's all out in the open. Mathematics is really there, for you to discover. The Prime Number Theorem was the same theorem before people were here, and it will be the same theorem after we're all gone. It's the Prime Number Theorem."

"In a way," Erdős says, "mathematics is the only infinite human activity. It is conceivable that humanity could

eventually learn everything in physics or biology. But humanity certainly won't ever be able to find out everything in mathematics, because the subject is infinite. Numbers themselves are infinite. That's why mathematics is really my only interest." One can reconstruct chapters of the SF's Book, but only the SF has it from beginning to end.

"The trouble with the integers is that we have examined only the small ones," says Graham. "Maybe all the exciting stuff happens at really big numbers, ones we can't get our hands on or even begin to think about in any very definite way. So maybe all the action is really inaccessible and we're just fiddling around. Our brains have evolved to get us out of the rain, find where the berries are, and keep us from getting killed. Our brains did not evolve to help us grasp really large numbers or to look at things in a hundred thousand dimensions. I've had this image of a creature, in another galaxy perhaps, a child creature, and he's playing a game with his friends. For a moment he's distracted. He just thinks about numbers, primes, a simple proof of the twin-prime conjecture, and much more. Then he loses interest and returns to his game."

We earthlings, where are we in our understanding of numbers? Each result—say, Erdős's proof that a prime can always be found between an integer and its double—although touted in the mathematics journals, is only an imperceptible advance toward some kind of cosmic understanding of the integers. "It will be millions of years before we'll have any understanding," Erdős says, "and even then it won't be a complete understanding, because we're up against the infinite."

IT IS LATE JANUARY IN SAN ANTONIO, AND MAYOR HENRY Cisneros, a rising star in Democratic politics, has proclaimed Math Day, in honor of the 2,575 mathematicians who have descended on the city for the annual conferences of the American Mathematical Society and the Mathematical Association of America. Cisneros's gesture has not advanced his cause with the conferees I am with, who wonder whether he has ever met a mathematician, let alone heard of Paul Erdős. The schedules include meetings to discuss whether mathematicians should accept Star Wars money and whether the National Security Agency, whose code-cracking wing is the largest employer of mathematicians in the United States, qualifies for corporate membership in the AMS. But except for a few zealots, most of the mathematicians have come to San Antonio not to discuss ethics and politics but to do mathematics. At physics conferences or psychoanalytic meetings, the participants do not perform experiments on subatomic particles or practice psychotherapy—they just talk about it. At mathematics conferences the attendees actually do mathematics, on blackboards, napkins, placemats, and toilet-stall walls, and in their minds.

Erdős rarely attends the scheduled talks at these meetings, preferring to work simultaneously with several mathematicians in a hotel room. Today Erdős has taken over

someone else's room at the Marriott and is working on six problems with six different mathematicians, who are sprawled across two double beds and the floor. "What about 647? Is it a prime?" asks a man who looks like a plump Moses. "I can no longer do them in my head." A woman in a multicolored dress comes to his rescue by pulling out a 276-page printout of all the primes up to two million—148,933 of them, ranging from 2 to 1,999,993. Sure enough, 647 is on the list.

Erdős doesn't seem to be paying attention. He is slumped over in a chair, his head in his hands, like an invalid in a nursing home. But every few minutes he perks up and suggests a line of attack to one of his colleagues, who then scrambles to implement the master's suggestion. The others wait patiently for Erdős to have a flash of insight about their problem. Sometimes when Erdős raises his head, he fools them, and they lean forward like the people seeking hot tips in an E. F. Hutton commercial. Instead of sharing a mathematical inspiration, he utters an aphoristic statement having to do with death—"Soon I will be cured of the incurable disease of life" or "This meeting, like life, will soon come to an end, but the meeting was much more pleasant"—and then bows his head again. No one picks up on these comments, and the cycle of mathematical insights and reflections on death continues all morning.

"In ten years," says the man who looks like Moses, "I want you to talk to the SF on my behalf."

"What do you want from the SF?" Erdős says.

"I want to see the Book."

"No one ever sees the Book. At most, you get glimpses."

Moses turns on the TV. "Television," Erdős says, "is something the Russians invented to destroy American education." The news comes on, and Ronald Reagan fills the screen. "Eisenhower was an enthusiastic but not very good golfer," Erdős says. "Someone said at the time that it was okay to elect a golfer, but why not a good golfer? I say, it's okay to elect an actor, but why not a good actor, like Chaplin?" Reagan dissolves, and the newscast switches to a story about AIDS. "Both bosses and slaves tell me people are less promiscuous," Erdős says, "but I wouldn't know." When the conversation strays from mathematics and death, it's a sure sign that Erdős is bored and ready to find new mathematical soul mates.

Two hours and five milligrams of Benzedrine later, Erdős is on a flight to Newark. From there he'll be going in quick succession to Memphis, Boca Raton, San Juan, Gainesville, Haifa, Tel Aviv, Montreal, Boston, Madison, DeKalb, Chicago, Champaign, Philadelphia, and Graham's house. His schedule has a small problem, however: two mathematicians in different states want him to open his brain to them at the same time. "You've heard about my mother's theorem?" Erdős says. "My mother said, 'Even you, Paul, can be in only one place at one time.' Maybe soon I will be relieved of this disadvantage. Maybe, once I've left, I'll be able to be in many places at the same time. Maybe then I'll be able to collaborate with Archimedes and Euclid." □